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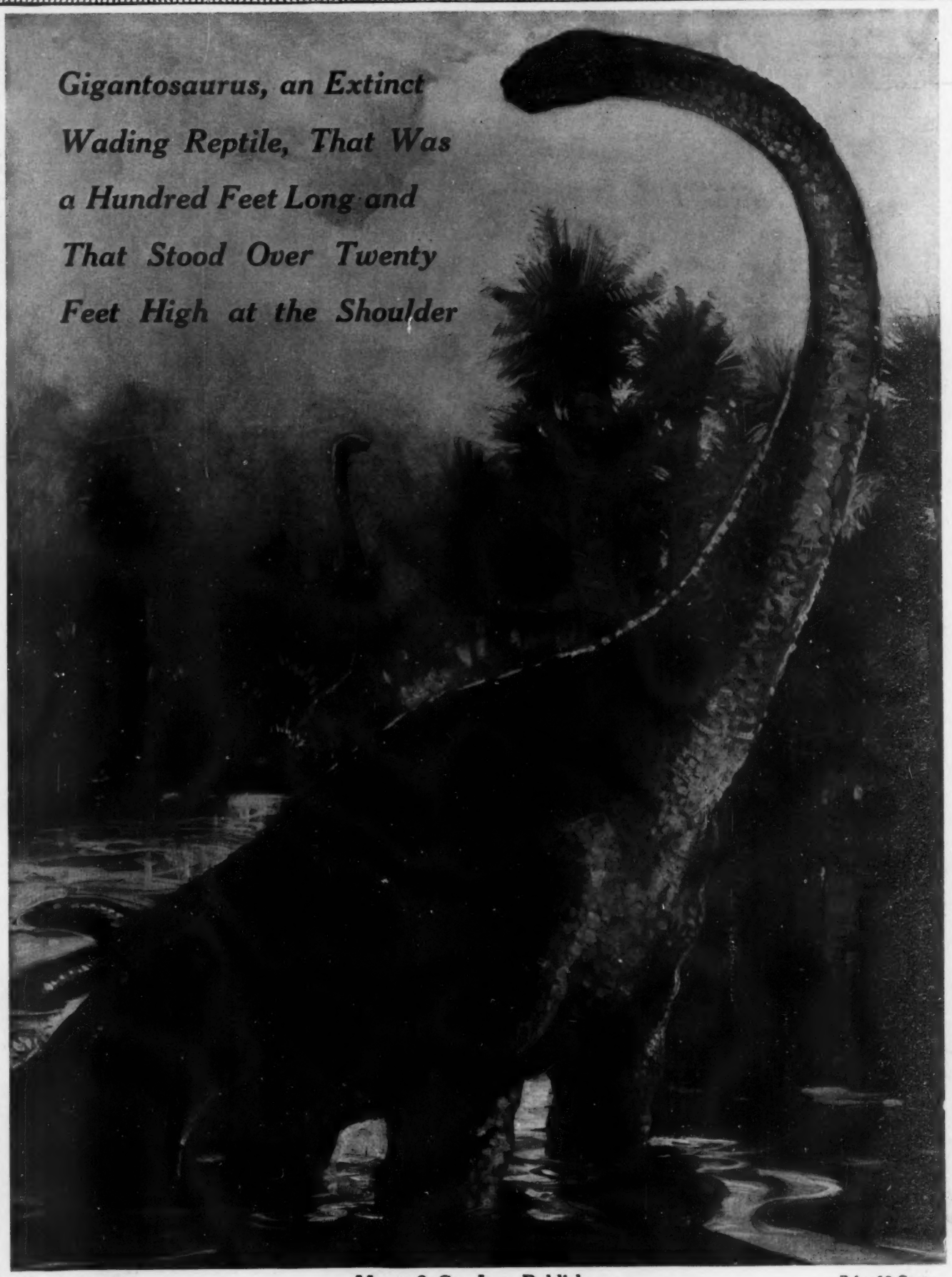

Gigantosaurus, an Extinct Wading Reptile, That Was a Hundred Feet Long and That Stood Over Twenty Feet High at the Shoulder

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Is Battleship Subdivision a Failure?

THE loss of the "Audacious" through contact with a mine has produced a sensation in the naval world which is comparable to that which followed the sinking of the "Victoria" several decades ago, through its being rammed by the "Camperdown." Theoretically the "Victoria" should have taken that blow, and, although injured, should have been capable of making port for repairs. Similarly, the "Audacious," of between two and three times her size and with an immeasurably better subdivision, should theoretically have been able to take that blow and survive it, creeping home, in a badly damaged condition, no doubt, but still in such shape that, after a few months in drydock, she would have been capable of taking her place, once more, with the fleet.

During the Russo-Japanese war, the mines took a fearful toll of the principal fighting units, both of the Japanese and Russian fleets. Nevertheless, it is a fact that there were occasions when a ship would bump into a floating mine, and yet would crawl into port, be repaired and join the line again in fighting condition. Thus, during the operations at Port Arthur, the battleship "Sevastopol" struck a mine on her starboard side, and some four hundred square feet of the plating and framing were driven in. Nevertheless, the ship got back to Port Arthur, and repairs were made, by means of a caisson externally applied, without the ship having to go into drydock. Some months later the same ship, when returning to Port Arthur from down the coast, again struck a mine, and by a curious coincidence she was damaged in almost exactly the same spot as before. This time, also, she managed to creep into harbor, and similar repairs were effected by the application of a caisson. These mines, however, must have been of much smaller size than the one which sank the "Audacious"; and the damage, although extensive on the outer hull of the ship, was localized in its effect upon the interior bulkheading.

Judging from the rapidity with which the armored cruisers "Aboukir," "Cressy," and "Hogue" sank after being torpedoed, it is probable that the Germans are using unusually large charges in the torpedoes which are carried by their submarines. Because the submarine can get within closer range of the enemy before launching its torpedoes, the latter do not have to travel through the great distances, and at the high speed which is necessary in torpedoes launched from battleships, cruisers, or even from destroyers. Some of the weight given up to air reservoir, motive power, etc., can be assigned to the explosive charge, which is made very much larger. It is possible that the German submarine torpedoes are carrying as high a charge as three hundred pounds of the most powerful explosive.

There is no hard-and-fast restriction governing the weight of charge that can be placed in a mine; and, judging from the results achieved in the case of the "Audacious," it is likely that the mine which sank her carried at least five hundred pounds of explosive. If we bear in mind that the destructive effect of the detonation of a mass of explosive varies as the cube of the charge, it can be realized how great was the disrupting power of the enormous volumes of gas which were let loose within the interior of the ship at the moment of detonation. The water on the outside of the ship being incompressible, the force of the explosion would seek the path of the least resistance, which naturally would lie through the comparatively frail structure of the ship; and it must be understood that the destructive energy would not be limited merely to bursting in the side plating and framing, but would be continued in the form of an enormous volume of gas under high pressure, suddenly putting under heavy stress the closed compartment or compartments immediately affected. It can be readily understood that the pressure thus engendered might be sufficient to start the seams for a considerable distance along the side of the ship, and to loosen up, not only the seams of the adjacent bulkheads, but also the edges of the bulkheads where they are attached to the inner bottom, the sides and the decks of the ship.

Experience in the testing of bulkheads on warships has shown that while they will remain tight under a head of 35 feet, or say 15 pounds, to the square inch, leakage will develop when the depth or head reaches 40 feet. Ordinarily bulkheads are designed to withstand a head or immersion of 35 to 37 feet. Now it can readily be supposed that the pressure of the gases thus expanded within the ship may have greatly exceeded the safe limit of 15 pounds; and, if so, although the bulkheading may not have been broken away, serious leakage may have been started throughout a considerable area of the interior of the ship. This leakage would be slow but sure; and it was probably this gradual inflow, impossible to prevent, that brought about the gradual loss of buoyancy of the "Audacious," which appears to have remained afloat for about thirteen hours after the blow was delivered.

Undoubtedly the disaster will cause naval constructors the world over to revise or greatly improve their present systems, already most elaborate, of subdivision. Lately the French have suggested that provision be made for limiting or checking altogether the inrush of gases by providing an interior longitudinal wall of armor, inwardly curved so as to present a concave face to the explosion. This would mitigate those leakage effects which take place when a plane vertical bulkhead wall is exposed to excessive pressure.

Let it not be imagined for a moment that this disaster in any sense seals the fate of the battleship. This still remains, and for many years to come must remain, the principal arm of a navy for winning decisive results. It must be borne in mind that, had it not been for the heavy sea that was running and the fact that the engines of the "Audacious" were disabled, she could have been brought back to her naval base, either under her own power or by towing. As it was, she was unable to move, and the heaviest towing cables made fast to the "Olympic" snapped like threads in the heavy scend of the sea.

Sources of Commercial Potash

WITH the check to imports of German potash caused by the war and the consequent rise in price of all potash salts, American manufacturers may find it necessary to consider domestic sources of supply.

Most of the potassium compounds used in pharmacy to-day are derived in the first instance from the famous salt deposits of Stassfurt, Germany, where the element occurs as potassium chloride, in the mineral called silvine, and as magnesium-potassium chloride in carnallite. The "potash" of commerce is obtained by the leaching of ashes from land plants, the ashes of sugar beets from molasses residues, and in the purifications of sheep suint. The product of wood ashes is purified by repeated crystallization from hot water and enters the market as "pearl-ash."

In a recent issue of the SCIENTIFIC AMERICAN, a correspondent drew attention to beet-sugar molasses as a source of commercial potash and suggested that the production of potash salts from beet-sugar refuse might be profitably carried on in this country.

The French sugar-beet sugar contains a notable proportion of potash salts, and the recovery of potash from the waste material of the stills used in treating beet-sugar molasses was an industry of some importance prior to the introduction of German potash, which became available in far greater abundance than was possible with beet-sugar refuse.

It may, therefore, be opportune to direct attention to early efforts in this country to provide material for the manufacture of potash salts. In a paper contributed to the American Pharmaceutical Association in 1892, Prof. John Uri Lloyd recalled the fact that American potash was formerly an article of much importance, and was exported from this country in large quantities. Years ago a well known American firm manufactured yellow prussiate of potash on a large scale. In the beginning of the work the crude potash was obtained principally from Michigan from forest stumpage, the ashes of the stumps being collected and leached in the final clearing up of the land. This potash, as shown in the paper by Prof. Lloyd, already referred to, was, as a rule, mixed with more or less common salt, in some instances being extraordinarily adulterated. The German potash, both carbonate and caustic, came along about the time the Michigan source was exhausted, and has continued to be used in chemical factories generally. Now that a scarcity of German supply impends it would seem that there must be an opportunity for the development of potash manufacture as a by-product of the beet-sugar industry, provided the American molasses of the beet contains the same proportion of potassium that was evidently present in the French sugar beet. Prof. Lloyd states that his firm used considerable quantities of beet potash imported from France, and the material was equal to the German as a basic substance for the manufacture of yellow prussiate of potash, though, naturally, the supply was somewhat irregular. Prof. Lloyd thinks it likely that the crude molasses of the South contains an abundance of potash, which, if there is a continued famine in German potash, might well be investigated.

Meanwhile, it is encouraging to note from a recent statement by Secretary Lane of the Department of the Interior that the home production of potash will be started at a plant in Searles, Cal., at an early date. The initial output will be only five tons a day, but the plant under construction is expected to ultimately produce 120 tons.

Edison's Clearness of Vision

WHILE the public at large are willing to give credit and praise to the inventor for his brilliancy of thought and originality of conception, as well as the persevering and painstaking research that often accompanies the development of a great and useful invention, yet it is not so frequently that it recognizes the clear and logical order of mental processes which are essential in such work. The inventor first has to appreciate the need which exists for some method or device, and then he contrives to fill this need as satisfactorily and efficiently as possible. It is, in short, a process of imagination, and the man with the most active imagination which can be controlled and directed into proper channels, will be the benefactor of the human race in science and industry, as well as in art, literature, and politics. Often this imagination will run far in advance of the realization of the inventor's ideals. Some far-seeing philosopher may visualize the future, but may be utterly deficient in mechanical skill or practical knowledge to carry into practice the visions he has conjured up. On the other hand, the really successful inventor not only is a man of vision, but one able to reduce to practice to the benefit of mankind his imaginative efforts.

A striking example of this may be seen in connection with the efforts of that great American inventor, Thomas A. Edison. Some of his recent appliances were described in the SCIENTIFIC AMERICAN of September 12th last. In 1876 the speaking telephone was exhibited by Bell at the Centennial Exhibition. In 1877 Edison brought out the phonograph, which was introduced to its first large circle through the pages of this journal. In the following year, 1878, Mr. Edison wrote describing the phonograph in an article which appeared in the *North American Review*, and which enumerated ten important uses this new invention would have. One by one mechanical ingenuity has brought to the public these important utilities in all save one respect, namely, a device for recording effectively a telephone conversation. That Mr. Edison realized the importance of this as well as the possibility is clearly indicated by the following extract from the article referred to:

" . . . Lastly, and in quite another direction, the phonograph will *perfect the telephone*, and revolutionize present *systems of telegraphy*. That useful invention is now restricted in its field of operation by reason of the fact that it is a means of communication which leaves no record of its transactions, thus restricting its use to simple conversational chit-chat, and such unimportant details of business as are not considered of sufficient importance to record. Were this different and our telephone conversation automatically recorded, we should find the reverse of the present status of the telephone. It would be expressly resorted to *as* a means of perfect record. In writing our agreements we incorporate in the writing the summing up of our understanding, using entirely new and different phraseology from that which we used to express our understanding of the transaction in its discussion, and not infrequently thus begetting perfectly innocent causes of misunderstanding. Now, if the telephone, with the phonograph to record its sayings, were used in the preliminary discussion, we would not only have the full and correct text, but every word of the whole matter capable of throwing light upon the subject. Thus it would seem clear that the men would find it more advantageous to actually separate a half mile or so in order to discuss important business matters, than to discuss them verbally, and then make an awkward attempt to clothe their understanding in a new language. The logic which applies to transactions between two individuals in the same office, applies with greater force to two at a distance who must discuss the matter between them by the telegraph or mail.

No more impressive or clearer statement of the deficiency of the telephone could have been written after thirty-five years of its active use. Essentially simple, yet practically difficult of realization, an instrument to meet this need has been developed by the efforts and painstaking exertion of Mr. Edison and his engineers, and we have to-day the new telescribe, or telephone recorder, as the result both of a brilliant inspiration and the logical development of a need seen by the prophetic vision of the great inventor.

Science

The Macapuno Cocoanut.—This curious sport fruit of the cocoanut, which occasionally grows on trees bearing ordinary cocoanuts, is described from the Philippines by B. M. Gonzales y Sioco. Instead of containing the ordinary watery "milk," the macapuno nut is nearly or quite made up of a viscous, white, translucent jelly, the texture of which next to the shell approaches the firmness of the normal cocoanut meat. There is no way of distinguishing this kind of nut, when intact, except by shaking it. It is said that trees which bear macapuno nuts will continue to do so from year to year.

A Deep Boring in Texas.—In an unsuccessful effort to find water for the town a boring to a depth of 4,489 feet was recently carried out at Spur, Texas. This boring gives interesting information concerning the stratigraphy of the region. There are three well-marked divisions. From the surface down to a depth of 1,250 feet are found red sands, clays, marls, beds of gypsum, anhydrite, and salt, including three beds of pure salt, ten, five, and nine feet in thickness. The next 2,850 feet consist of dolomite, with strata of anhydrite, sandstone, and shale. The lowest 389 feet are limestone and shale.

Preserving Mulberry Leaves in Cold Storage for the use of silkworms has recently been investigated in Italy by P. Buffa, who reports excellent results under the following conditions: The temperature of the storage chamber should be constant between 33.8 and 35.6 deg. Fahr. It is best to precool the leaves for a few hours before putting them into the chamber. Free ventilation should be allowed in the boxes, which should not be of greater capacity than about 3 cubic feet. The stored leaves were eaten with as much relish by the silkworms as fresh leaves, and gave exactly as good results.

Aerial Tubers in Potatoes are described by Th. Foitik in a German agricultural journal. They were observed on three varieties, occurring on the main stem or branches, singly or in clusters. They are grass green with purple spots, and often bear nodosities from which, or from the tubers themselves, rosettes of soft leaves may arise. Some are as big as pigeons' eggs. The tubers form especially on haulms which have been bent down to the ground, and appear to be favored by heavy fertilizing and damp weather. The writer planted some of these aerial tubers, and obtained from them yields heavier than the average of the variety.

Velocity of Wireless Telegraphic Waves.—An interesting paper has been read before the Academie des Sciences in Paris describing experiments undertaken to determine the velocity of propagation of the waves used in wireless telegraphy. A station A_1 emits a signal to which another station A_2 replies by a second signal. At the station A_1 one notes the time T_1 which elapses between the departure of the first signal and the return of the second. In the second station A_2 the time T_2 is noted between the reception of the first signal and the emission of the second. Obviously T_1 is greater than T_2 and their differences $T_1—T_2$ is the time taken for a signal to pass from the station A_1 to the station A_2 and back again. Three experiments were made: from Paris to Toulon, Paris to Toul, and Paris to Washington. The method employed to measure time enabled one to measure precisely an interval of one hundred-thousandth part of a second. It was found that wireless telegraph waves are propagated along the surface of the earth with a velocity slightly inferior to that of light.

Ice Fringes on the Stems of Plants.—This curious phenomenon occurs on plants of comparatively few species, and appears not to have attracted much attention. It has, however, been described, with attempts at explanation, by Sir John Herschel, John Le Conte, and a few others. In the current *Journal* of the Franklin Institute an interesting discussion of the phenomenon is published by W. W. Coblentz, of the U. S. Bureau of Standards, who reports the results of his own observations on the ice fringes of dittany (*Cunila mariana*). The fringes form in freezing weather, especially in the autumn, in the form of delicate loops, ribbons, or curled plates of thin ice, which are evidently not a form of hoarfrost, as the amount of ice is much in excess of that which could be condensed out of the atmosphere. The moisture is undoubtedly supplied by the plant itself, but the mechanism of the process was obscure prior to Coblentz's observations. These seem to prove that the moisture is exuded from the stems by capillary attraction, and the phenomenon is therefore similar in origin to the ground-frost formed on the surface of wet soils, except that in the latter case a particle of gravel usually forms the nucleus to start the congelation. When the moisture within the stem is frozen fringes cannot form, nor do they occur when the ground is frozen to the depth of an inch or more. The size of the ice fringes and the height to which they extend above the ground depend upon the rate of evaporation from the stem and upon the amount of moisture in the ground. Fringes form most readily and abundantly on stems having a great number of sap-tubes; differences in the anatomy of their stems explain why some species form fringes while others do not.

Automobile

English Motor Car Show Abandoned.—For the first time in a number of years, there will be no show of motor cars in England in 1915. The energetic fashion in which the warring nations have been pushing their hostilities is responsible for the abandonment of this annual function at Olympia.

Mirrors on Commercial Vehicles in New Jersey.—By way of increasing the safety of pedestrians and the occupants of other cars, the New Jersey legislature has ordained that after January 1st, all commercial vehicles must carry mirrors which will afford their drivers an unobstructed view to the rear.

"Light Car" Coming into Vogue.—It is a noteworthy and significant trend of the times that the term "cyclecar" as applying to small, narrow-tread vehicles, is passing. Such vehicles in the majority of cases now are termed "light cars" by their makers, and it might be added, the new designation is the more becoming and the more suggestive of the vehicle itself, of the two.

Foreign Motor Car Shows Abandoned.—As might have been expected, the foreign war situation which is tearing at the vitals of so many European countries, has resulted in what is practically abandonment of the French and British Motor Car Shows. As a result, additional attention will center about the forthcoming American displays which will be held in New York and Chicago as usual.

The Eight-Cylinder Car is Coming.—Lending point to the statement in the editorial in SCIENTIFIC AMERICAN for September 5th, that we may in the near future contemplate a wave of eight-cylinder popularity, there already has appeared the announcement of another maker who will bring out an eight-cylinder model this fall. This is the second who has looked with favor on the eight with never a glance at the six. Neither maker had heretofore produced any but four-cylinder models.

Wanted: A Good Motoring Cap.—As simple as it may seem, it yet appears difficult for makers to produce a really good head covering for motoring. The usual peaked cap appears most popular, but is apt to blow off unless the peak is reversed, which gives the wearer too much of a "speedy" appearance. The ideal hat must fit the following specifications: It must be presentable; it must provide protection from dust; it should be washable and waterproof; it should incorporate goggles which, when not in use, can be made invisible, but which must be instantly available; it must not blow off; it should be light and warm; it should have a peak to protect the wearer's eyes from the sun.

The Sentiment for Right Drive.—Although the past year has seen virtually every automobile manufacturer change over from the right side for the steering wheel to the left side, not everyone views left side steering with favor. In fact, slight sentiment against left steering of late appears to be developing upon the ground that those who steer from that side incline to "hog" the road and so lay not only themselves but others as well open to the danger of accidental collision with other cars. Those who operate left side driven cars appear to dislike to drive as far to the right side of the road as it would seem necessary to do for safety. In other words, they prefer to drive nearer to the center of the road in order that they may have a better view of the right side ditch.

Car Census Shows Nearly Two Million.—According to the latest census figures covering automobile registration in the various states, there are now 1,735,369 automobiles in use in the United States. There has been a steady gain since the first of the year. These figures are both for gasoline and electric pleasure and freight vehicles. On January 1st, 1914, there were 1,253,875 cars in use. By the latest census, New York is far in the lead with 160,475 cars registered. Illinois is next with 126,681 and there are only four other states in which the figure runs 100,000 or over. These are Pennsylvania, Ohio, California and Iowa, in that order. The State of Nevada has the fewest cars, the registration showing but 1,523 in use.

Foreign Cars Now Sold Fully Equipped.—Although it has been the custom abroad for a number of years for car manufacturers to sell their product virtually "bare," of late there is a very noticeable tendency for these same makers to sell their cars, as the British say, "all on." This means, briefly, that instead of purchasing the car and afterward shopping around for horn, windshield, top, lamps, demountable rims, number plates, and, in fact, about everything of the kind that is a real necessity, the car is purchased with all these things properly fitted in place. Not more than three years ago it was the exception for a purchaser to get a car fully equipped from the maker; now it is the rule. Obviously, the various accessories are more suited to the vehicle when fitted by the car maker, who thus is assured of their adaptability. It is stated that the present war has had a notable effect in this respect, for it has given engineers more time to devote to details because of the slacking off in demand. Parts which might have served quite well for another season, it is pointed out, have been redesigned and improved, an improvement which might not have been made for another year.

Inventions

Novel Amusement Apparatus.—Frederick J. Gibson of Oakland, Cal., has patented, No. 1,107,287, an apparatus in the form of a merry-go-round in which the cars are like aeroplanes and a motion is produced simulating that of such machines, so the users will in a measure experience the sensations of an aeroplane ride.

An Apple Grader Adjustable to Different Sizes.—James R. Nunamaker of Hood River, Oregon, has secured patent No. 1,109,866 for a machine for mechanically grading apples or the like. The grading devices proper are adjustably supported so that they may be set to effect any particular grading desired.

A New Type of Telephone Holder.—A telephone arm of telescope construction has been invented. In construction it consists of three octagon shaped tubes, one fitting within the other, in such a manner that when the telephone is clamped to the holder at the outer end and the socket attached firmly to desk or partition, the arm can be extended some 30 inches and pushed back, or telescoped, to 10 inches, thus making a very neat and compact holder.

Smoothing the Edges of Collars.—It is well known that the modern mechanical laundry methods are very hard upon linen, and collars or cuffs soon have a rough edge which irritates the skin, even though scarcely visible to the eye. To avoid this it suffices to run over the edge a small rod having a suitable groove near one end, so as to flatten down the rough edge. A neat Paris device embodies this idea and also another useful one, for the pointed end of the rod serves as a buttonhole opener.

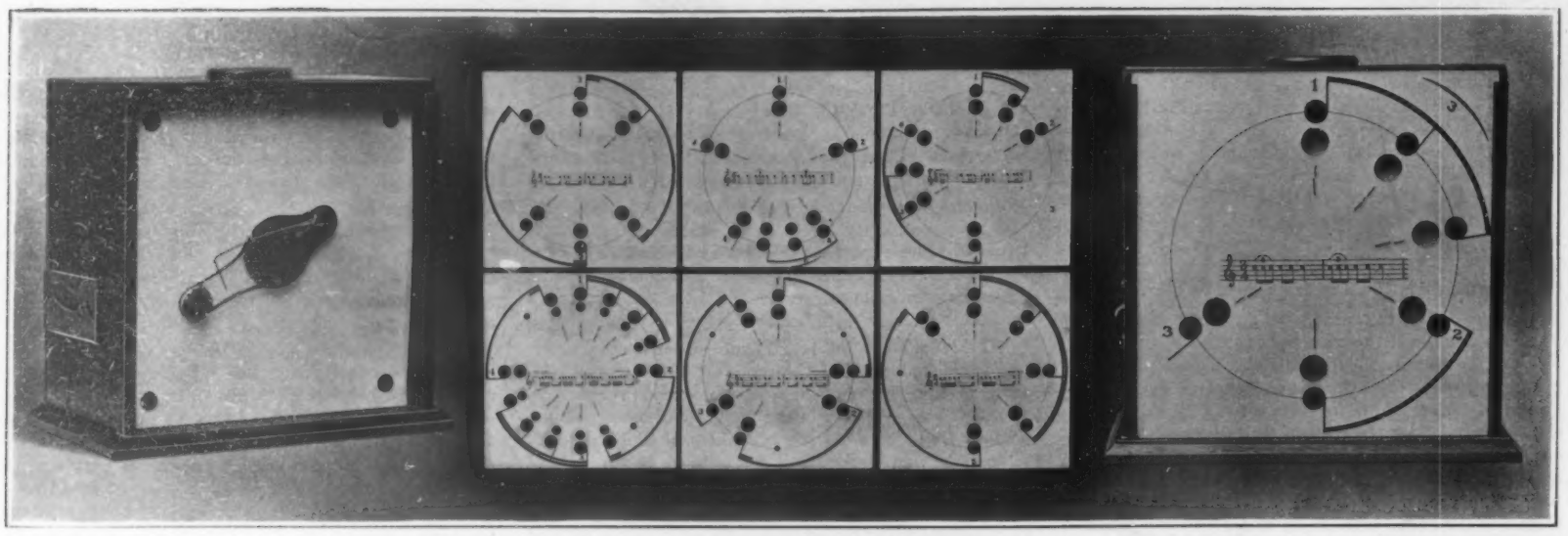
A Parachute Patent to Emile Berliner.—Emile Berliner, the well-known Washington inventor, has secured patent No. 1,110,180 for a parachute designed especially for use in connection with helicopters and so shaped as to secure a maximum retarding force for a given area of surface without disturbing or destroying the equilibrium of the parachute which is shown as shaped like a Japanese parasol with the edges curved upwardly in such manner as to form a circumferential trough which causes a partial vacuum at the outer edge of the parachute during its descent.

Traveler's Smoothing Iron.—A somewhat unusual but what appears to be a really practical device is of recent Paris invention, this being a traveler's smoothing iron, self-contained with its alcohol heater. Ladies will appreciate the convenience which is afforded by having an iron ready at hand, for on arriving at the hotel, clothes in trunks or valises are often sadly rumpled. It is then an advantage to have at hand the means of repairing the damage in a very short time, and in the neat leather case only 5 by 3 inches are lodged the iron and its alcohol lamp, the latter having a good sized asbestos burner.

Twenty-Four-Hour Clock Dials.—Now that 24-hour time is officially adopted in France, inventors have been at work upon a double-figure dial. One method is to use red figures underneath the ordinary figures, that is, 13 would come under 1 o'clock, and so on. An ingenious idea has, however, been found for watch dials, and a complete watch is now on the market which contains this makeup. The dial face has a set of 12 holes instead of the usual figures, and back of this is a rotating enameled disk with the Roman numerals from 1 to 12, and just beside them Arabic numerals from 12 to 24. First the Roman numerals appear in sight under the holes, then by pressing a button which lies above the winding stem the disk shifts around slightly so as to bring the other set of numbers into place.

Tapping Champagne Bottles.—Devices have already been invented for plugging into the corks of champagne bottles and the like so as to deal out the fluid in small quantities through the inserted tube. A new French device of simple construction has the general shape of a corkscrew, and is run through the stopper by a small screw placed on the end of the long tube. Small holes just above the screw admit the liquid to the top. At the upper end of the tube near the handle is a second screw thread which engages in the cork and makes a tight joint to prevent escape of gas. To deliver the liquid, the bottle is tilted flat so that the corkscrew handle is vertical, and by pushing a spring plug in the top end of the handle, the liquid flows out through the other end into the glass, the corkscrew handle being made hollow for the purpose.

Rubber Stopper Device.—We remark what appears to be one of the best devices for stopping bottles for travelers' use. It is made in Paris, and consists of a solid rubber cork having a prolongation at the top in the shape of a rubber tube portion of about the same length as the cork itself and of slightly larger diameter so as to come near the size of the bottle flange. Fitting in the stopper, the flexible upper or projecting part is then turned down all around so as to fit tight upon the bottle head and surround it for half an inch below the top. The whole then resembles what would be given by a cork and a metal bottle cap of the usual kind, but the use of rubber makes a flexible protector. Of course stopper and flexible part are all one piece of rubber.



Front interior view, with apparatus by which a loud click supplements the red spot.

Cards in various measures for musical performance—2/4, 5/4, 6/8, 4/4, 3/4, and 2/4—ready for insertion in the rythmikon.

The 3/4 card inserted in instrument, with the red spot appearing in the first hole at left.

The Rythmikon—a New Aid to the Study of Musical Rhythm

By Harry Chapin Plummer

YOU have listened to the "song of the wheels," that uncadenced monotone so familiar to the railroad man and the traveler; you have sunk into the unconscious state and have been alive only to that "click click" and unending pound of steel upon steel. And, it may be, in such a moment you have thought of music, and some favorite song has stolen upon your senses, and, catching the perfect rhythm of those revolving wheels, has poured forth before your startled mental vision a very pean of melody.

A young English violinist, of the name of Bonarios Grimson, on his railway journeys, repeatedly experienced this sensation. Dozing in his compartment, he would be struck with that rhythmic monotone of wheels and rails. No sooner would the train settle down to a long stretch of level road than snatches of some of the great epics of violin literature would come to him, hazily, dreamily, then with sudden definiteness of lyric outline.

So, while he traveled, young Grimson thought, and his impressions took the form of a single idea. Like all musicians, he had long been conscious of the vexatious problems that arise in determining certain rhythms. The metronome, that mercilessly faithful little instrument which practising pupils had ticking on the key-block of a pianoforte, supplied but a clock-like beat of 1-2-3-4, scarcely an improvement upon the pendulum of old, which musicians of the seventeenth and eighteenth centuries employed.

"In listening to revolving wheels," Grimson declared recently, "I was impressed by the inevitable regularity of the motion, and the thought struck me that in playing music, if one could only break up this regular, circular rotation into certain combinations of beats, the problem of rhythm could be solved for once." Gradually he experimented with wheels until he had perfected a device which he styled a Rythmikon. By means of this apparatus the exact rhythm that is wanted by the musician will be ticked, merely by the insertion in a slide of a key supplying the particular meter of music called for.

The Rythmikon is based on the theory that a revolving wheel, marked at one point of its circumference, almost insensibly impresses upon the mind the steadiness—the inevitableness—of its rotation, and that the mind is commanded by the eye to observe the mark upon the wheel as it appears at every revolution. Look away from the wheel for a little while, and you will know just when to look back to catch the mark as it appears. Thus is the sense of time born—the mental division of abstract time into equal periods.

The Rythmikon consists of a revolving hand bearing a large red spot, in front of which are placed cards bearing any desired rhythm, printed as it would appear in written music, and then enlarged and properly spaced along a circular path. Corresponding with each written note is an opening in the card through which the red spot on the revolving hand becomes visible at the moment when the note is due to be played. A loud click further calls attention to its appearance. The completion of each revolution—i. e., every measure—is announced by a bell-stroke. Thirty-two rhythms are an appendage of each instrument, for purposes of study. Afterward the use of three metal plates commences.

One of these has 16 openings, the next 18, and the third 24, and virtually every known musical rhythm can be produced with one or another of the plates, which is inserted in the Rythmikon in the usual manner. When all the openings are closed there is no sound audible but that of the bell, but as the openings are uncovered the red spot appears, and at the same time a "click" is heard. These three plates are the final means of cultivating the sense of musical rhythm to the nearest approach to absolute perfection.

The speed at which the instrument may be operated can be altered at will by a simple adjustment of the knob at the back of the case, and the speed-rate will then be recorded upon the indicator at the side.

It is not intended that the Rythmikon shall be used while playing a musical instrument or in any way but as a separate and auxiliary study, which is designed to render outside assistance needless.

The speed-indicator is marked in revolutions per minute, for the reason that the Rythmikon is based on the initial idea for measures and not for beats, the beat being regarded as important only in its relation to the whole measure. If a card in 3/4 time is inserted, and it is desired to run it at a metronomic speed of 102, it is obvious that the speed-indicator must be set at 34, which will give a beat-speed of 102. Should the card be in 6/8 time, the speed-indicator must be set at 17, and so on. This feature alone has a very definite educational value in arriving at complete independence of all mechanical aids.

It is not intended so much that the machine be operated simultaneously with the performing of music, but that the player or singer listen to the rhythmic beat before performing a tricky piece of music. He may listen for a few moments; soon the rhythm will have made a definite impression on his consciousness, and the actual performance will follow without the mechanical effort that otherwise would be needed.

Let us suppose that the student is attempting to master a composition in which the time is syncopated in a manner that defies virtually the beating of time. With the aid of the Rythmikon it is necessary only to analyze the distribution of beats in a series of bars and adjust the machine to it. Then the student sets the machine going, with the result that the peculiar distribution of beats is recorded with mechanical accuracy. The subconscious mind quickly comprehends the peculiar rhythm, and the problem is negotiated without difficulty.

Ultra-violet Rays for Water Purification in Army Service

THE present war disaster in Europe makes it interesting for one to review some of the methods used for protecting the soldiers in the field against the dangers of infection from impure water; for it is recognized that maladies such as typhoid, cholera, and dysentery are propagated by the drinking water, and are far more dangerous to the soldiers than the bullets of the enemy. It is for these reasons that modern armies now employ water purifying apparatus.

Several methods have been applied for freeing the water of dangerous bacteria. One of these is that of filtration, which is effective in clearing the water, but cannot be depended upon safely to eliminate bacterial life. The results of such filtering plants used during the French Morocco campaign and the German colonial war seem to have been unsatisfactory.

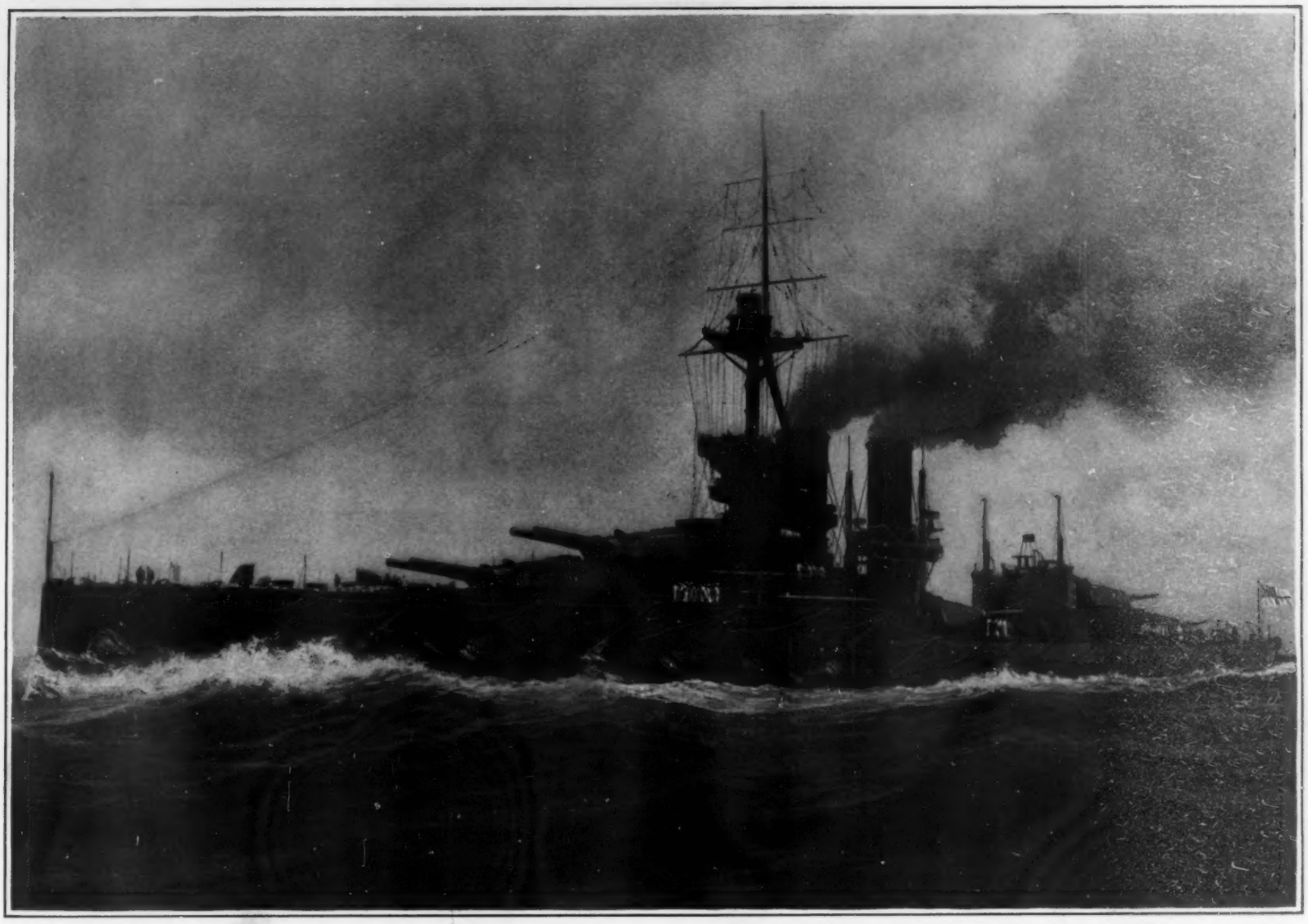
Another method is that of heating the water. Apparatus of this kind have been used in the field, but have proven objectionable as they not only raise the temperature, but produce a water which is far from palatable, by removing all the beneficial salts and gases. Chemical treatment presents so many difficulties, and the results are so unsatisfactory, that it is scarcely worth mentioning in this connection.

A device of unusual interest is an arrangement for the application of the ultra-violet rays, the germ killing properties of which make possible a field sterilizer, which can pick up polluted water and produce therefrom sound drinking water and even water for surgical use. The apparatus for this purpose consists of a white enamel tank, in which the water is made to flow near a strong source of ultra-violet radiation, this source being a mercury vapor lamp made of quartz glass. A number of baffle plates are so arranged that the water is agitated and made to pass several times under the influence of the ultra-violet rays. Both the French and Austrian armies now have devices of this kind for sterilizing the water in the field. It was first introduced by the French army in the Morocco campaign, camels being used to carry the apparatus and all the accessories for using it. Surgeon Major Tanton,

(*Concluded on page 445.*)

The ultra-violet ray apparatus supplying sterilized water.

Austrian artillery car fitted with ultra-violet ray sterilizer.



Date, 1913. **Tonnage,** 23,000. **Speed,** 21.5 knots. **Side armor,** 12-inch, 9-inch, and 7-inch. **Guns:** Ten 13.5-inch, sixteen 4-inch. **Torpedo tubes,** three 21-inch.

The British dreadnought "Audacious."

The Loss of the "Audacious"

Mines, Laid on the Trade Routes, Sink a British Dreadnought

A FEW weeks ago, and fully two weeks before the loss became known to the public, the British dreadnought "Audacious," one of the four ships of the "King George V." class, struck a mine off the north coast of Ireland, and went to the bottom.

This disaster came as a sequel to the warning cabled over at about the time when the loss occurred, that the northerly coast of Ireland had been mined, and shipping, using this trade route, should keep outside of certain specified waters.

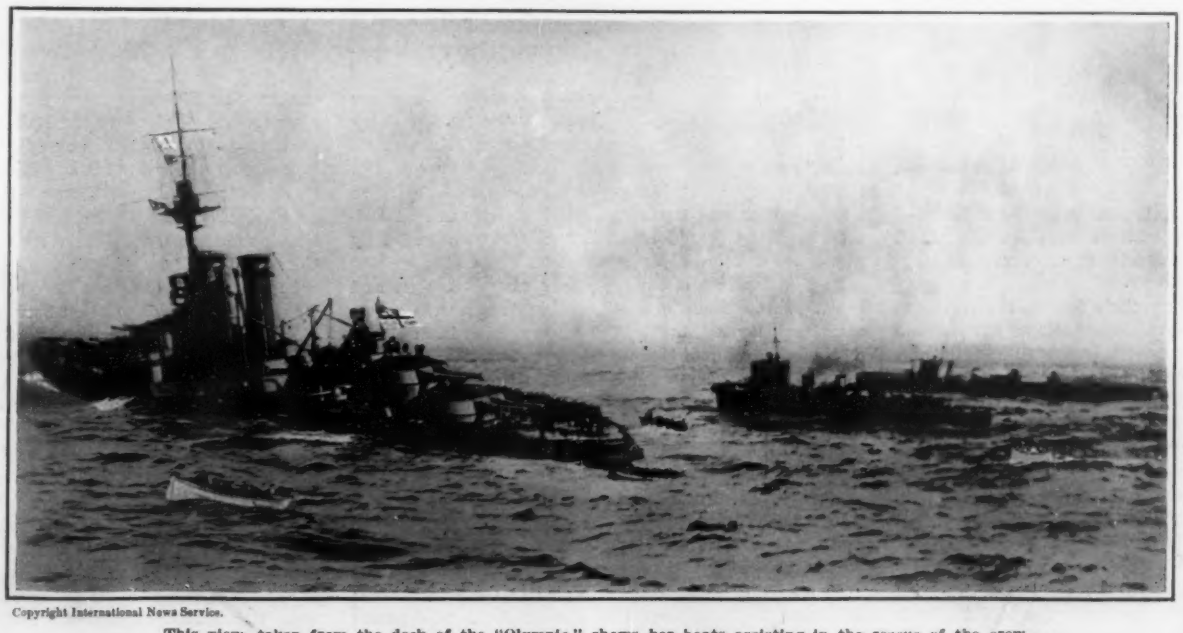
That the "Audacious" was sunk by a mine, and not by a submarine, is suggested by the announcement, recently made by Premier Asquith in the House of Commons, that the British government had decided to declare the whole of the North Sea to be in the military area. In this connection he said: "In the last week of October the Germans succeeded in laying a mine field off the north coast of Ireland, on the main trade route from America to Liverpool *via* the north of Ireland. Merchant ships were blown up and lost. . . . The menace to peaceful shipping presented by these wholly illegal methods of waging war is so great that the government has been compelled to adopt the only possible means of protection, namely, to declare the whole North Sea a military area, and to restrict all shipping crossing it to a narrow passage, along which the strictest supervision can be maintained."

The sinking of the "Audacious" is by far the most serious loss yet sustained by any of the naval powers engaged—in fact, in its bearing upon the actual fighting strength of the British navy it is equal to the sum of all the losses previously suffered. For the "Audacious" was a capital or first-line ship, one of those major units which must line up against the enemy in that supreme and decisive engagement (if it ever takes place) when the German battleship fleet emerges to fight it out to a finish in a great fleet action. The crew were saved; but this noble ship, representing a cost of from $12,000,000 to $13,000,000, is a total loss.

And yet, so vast is the British navy, and so great is its ship-building capacity, that in spite of the loss of the "Audacious," the dreadnought fleet still numbers 30 ships, and by the first of next month will number 32 ships, the 23,000-ton, 21½-knot "Audacious" being replaced by the 27,500-ton, 25-knot "Queen Elizabeth" and "Warspite." These are ships of vastly greater power, mounting the new 15-inch gun in place of the 13.5-inch gun carried by the "Audacious." Moreover, by the first of March, three additional ships of the "Queen Elizabeth" class will be completed, thus raising the total dreadnought strength of the British to 35 ships, as against 31 at the opening of the war.

We have already stated in these columns that, because of

(Concluded on page 445.)



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This view, taken from the deck of the "Olympic," shows her boats assisting in the rescue of the crew.

Sinking of the "Audacious" by a mine off the north coast of Ireland.

The mobile French infantry.

French machine gun section advancing against German position between Mondidier and Roye. The machine gun in this war has played an important part; it is so mobile. Each man carries a part, and it can be ready for firing at a moment's notice.

Strategic Moves of the War

Letter from the Military Correspondent of the Scientific American, November 21st, 1914

The French Campaign.

THE battle line in France and Belgium has presented an unusual instance of the opposing forces on both sides acting on the defensive. The Allies are well content with this rôle because they feel that time will improve their chances through enabling them to better equip their troops, especially in regard to heavy artillery. The Germans have adopted the defensive temporarily in this field in order to enable them to throw greater strength into the campaign against Russia.

This does not mean that the armies rest idle, fighting only when attacked. It means that no general aggressive move is attempted involving one or more of the armies into which the fighting forces are divided. Each organization must, however, keep in close touch with the enemy in its immediate front. By aerial reconnaissances and by assaults of small columns they keep track of the enemy's movements. If a weak point is developed anywhere, more troops are rushed in and in some cases the enemy's trenches are captured. In the fighting in France during the last three weeks the various successes reported have been such minor gains. The enemy falls back a few hundred yards, entrenches again, and the contest is renewed.

The most active operations have been in Belgium. The opening of the dikes along the Yser Canal both north and south of Dixmude has flooded a fifteen-mile stretch sufficiently to prevent the advance of large bodies of troops. Consequently, the center of fighting has moved southward to the vicinity of Ypres.

Here the Germans have made a determined effort to break down the opposition of the British troops. During the first days of this month the German assaults were made in great strength by the reserve troops that had just reached the front after service in the capture of Antwerp. The British were driven back five miles from Roulers to Ypres and Bixschoote, but succeeded in stopping the attacks.

After a period to recoup their losses, the Germans again launched their assaulting columns against the British position at Ypres on November 10th, 11th, and 12th. The importance that they ascribed to success in this field is shown by the presence of the British Guard Corps in the attacking force. This elite organization is composed of the best blood of the empire and is given the post of honor where decisive results are expected. These assaults also were repulsed by the British, who fell back at points but regained their original line.

Similar attacks were delivered on the French at Bixschoote and on the British at Armentieres, but with like results. The object of this move was to drive back the left flank of the Allies and to capture Dunkirk. By attacking at Ypres, the Germans secured the advantage of the direct line of rail through Brussels and Liège for rushing troops and supplies to the critical point. They also had a chance to cut off and capture the Belgian army in case they should succeed in breaking through.

The German force in Belgium was weakened during the week by the dispatch of their cavalry to the Russian border. The Uhlans and dragoons were of little use in the intrenchment warfare except as an indifferent substitute for infantry. In the east, though, they were very much needed to oppose the raids of the Russian Cossacks. Consequently, the greater part of the mounted troops from France have been transferred to strengthen the latest German strategic move from Posen.

While pushing this countermove against the Russians the Germans have slackened the impetuosity of their attacks in the west. They still continue on a smaller scale, but are now made largely to screen the reduction of German strength. This campaign or battle in France has been noteworthy in the world's military history. In spite of being outnumbered five to four, the Germans have not only maintained their line for ten weeks, but have forced the fighting.

This is one of the best evidences of the unprepared state in which France and Great Britain were caught. Both countries had been making partial preparations for two years against this eventuality, but neither seems to have gaged the strength of the effort of which Germany was capable.

The great value of the Belgian resistance now shows more clearly. If it had not been for the ten-day delay in the German advance caused by Liège and Namur, the British would have been unable to join the French, and the latter could hardly have stopped short of the Loire without disaster. Certainly, if Great Britain and Belgium had not joined the Allies, the French would by now have suffered serious reverses.

The Allies in France now have abundant men and small arms. Their delay in making aggressive movements can be explained only by a weakness in artillery. These guns cannot be made in a hurry when need arises. With every resource of these two great nations, it will take them four months to turn out the first equipment of heavy mobile artillery that is needed to support attacks on intrenched positions.

In Lorraine and Alsace the French have profited by the weakness of the German armies in these regions. The French have once more forced the fighting back to and across the border. East of Nancy the French occupation of Nomeny, Champenoux, and Cirey brings them once more to the positions occupied in the second week of August. In Alsace the French hold the passes through the Vosges and have captured Thann and Altkirch, ten miles east of the border.

The Russian Campaign.

The campaign in the eastern theater of operations has developed a further Russian advance in East Prussia and Galicia and a new aggressive move by the Germans in Poland.

The campaign in East Prussia has been subordinated to that in Poland. The Russian successes here are due mainly to the transfer of German troops to other fields. Until this occurred the Russians were held fast to the line through Stalluponen, Goldapp, Lyck, and Bialla. The importance of a continuous feeling-out of the enemy's lines by scouting and by attacks in force is shown by the promptness with which the Russians pushed the Germans back when their strength was reduced.

It is noteworthy in this campaign that the Russians are avoiding the lake region along the southern border in which their army was tangled up and beaten by Gen. von Hindenburg in September. The Russians now seem content to hold back in this region while pushing their advance in the north. Here they have succeeded in forcing the Germans back to Gumbinnen and the Angerapp River. The Germans, though, still hold their advanced position at Pilkallen. The Germans need every man possible for their campaign in Poland, so the Russians must have a large superiority of numbers in East Prussia.

If the Russians can continue their advance on Koenigsberg they will in time clear the lake country and enable their forces to move forward to a straight line running from Poland to the Baltic Sea. Their big disadvantage lies in their lack of railways. When their forces are concentrated in one district they have to stay there, while the Germans can shift their armies to make successive attacks in force at different points. The Russian advantage in numbers is thus offset by the German mobility.

In Poland the Russians have been checked before the German entrenched position between Sieradz and Czenstochowa. In their retreat the Germans destroyed all railroads and bridges and left the roads well-nigh impassable to vehicles. Consequently, the Russians in their pursuit had to leave most of their artillery behind. The freezing up of the country has facilitated the operations of their troops, and the arrival of heavy guns and of new troops at the front should soon warrant a resumption of aggressive tactics by the Russians.

Meanwhile the Germans are making another strategic move similar to the one in October that drove the Russians back to the Vistula. The garrisons from the lower Vistula forts were collected at Thorn and troops were transferred from East Prussia, from Silesia, and even from Belgium, to strengthen the German offense.

On November 12th they started their forward move

from Thorn to outflank the Russian army to the south. The Russian resistance was overpowered and the new German army swept on to Lipno, Plock, and Kutno, half way to Warsaw. On November 16th the Germans had reached a line through Mlawa, Bielsk, Plock, Kutno, and Uniejow on the Warthe, ten miles south of Kolo.

The Russian cavalry raid that penetrated to the vicinity of Pleschen was quickly driven back by the Germans. Their communications were thus made secure, enabling them to maintain their position along the Warthe from Sieradz to Czenstochowa.

In Galicia the Austrian resistance has crumpled. The main Russian campaign has been directed against Cracow and has steadily pressed the Austrians back. On November 9th the Russians had reached Pilica and Miechow, twenty miles from Cracow. By the 15th they were five miles closer, and on the 17th they were attacking the outer line of forts.

This advance placed the Austrian army in Galicia in a dangerous position. If the Russians should break through, they would cut the Austrians off from their normal line of retreat through the open country south of Cracow. A retreat through the passes of the Carpathian Alps at this season would be so difficult as to expose the rear of the columns to being cut off while delayed by the slow progress in front.

Consequently, the Austrians have abandoned central Galicia and have drawn in their armies to the west to strengthen the resistance on the Cracow line. On November 12th the Russians occupied Tarnow and Sanok, and on the 16th they had gained Jaslo and Dukla, while Cossack columns had seized the passes of the Carpathians from Dukla to Bukowina.

The advantage in the fighting in this theater lies, so far, very much with the Russians. They are confronted now with the threatening move of the Germans from Thorn. If the Germans succeed the Russians will have to give up their campaign against Posen, while the East Prussian gains will amount to little. If, however, the German move is stopped, the Russians will be free to prosecute their winning campaigns in all three localities, East Prussia, Poland, and Galicia. In any case, the Russians seem unlikely to lose their recent gains in this last district.

The Legal Definition of a Patent

By Hon. Thomas Ewing, Commissioner of Patents

IN popular language the word *patent* means the original document, or a printed copy of the illustration and description attached thereto, or the invention itself, or some particular physical embodiment thereof. What I wish to discuss is the mutual legal rights of the parties evidenced by the document constituting letters patent.

1. A patent is a contract, and just as every written memorandum of an agreement is merely an indenture witnessing the agreement, so the letters patent are merely evidence of a contract.

Under the old procedure in England, where our patent system originated, some of the patents were in the form of indentures. The patents were granted as an exercise of the prerogative of the Crown, and the Crown was at times a part owner. James I invested one hundred thousand pounds sterling in the Royal Alum Works, which operated under a patent.

In this country the right to reissue patents was introduced into our practice on the theory that the patentee was merely exercising the right of correcting a contract. This practice in the absence of any statutory provision therefor was sustained by the Supreme Court of the United States speaking through Chief Justice Marshall in the famous case of Grant v. Raymond, reported in 6 Peters.

2. The consideration for a patent is the disclosure of a new and useful invention in the specification of the patent. As Lord Eldon stated in Cartwright v. Eamer, patents are to be "considered as bargains between the inventors and the public, to be judged of on the principle of keeping good faith by making a fair disclosure of the invention."

3. Anyone having an invention to communicate may obtain a grant. So long as the matter rested in the prerogative of the Crown this was not true. The Crown might exercise its prerogative or not, as it chose. But when the prerogative of the Crown was lost, the principle that all men are equal before the law eliminated any element of favor from the granting of patents.

4. With the disappearance of the royal prerogatives, there disappeared also another conception, viz., that the right to use the invention arises out of the grant. The old English patents contained two separate clauses, one specifically granting the right to use the invention, and the other prohibiting anyone else from doing so. These grants were made at a time when it was customary for kings to grant licenses to trade. When, however, it became established that freedom of trade is the birthright of every subject or citizen and monopolies were strictly limited to new manufactures, the grant carried with it no right of use and no restriction of established trade, but merely the right to exclude others from the enjoyment of the new thing. The phrase of the granting clause of our patents, "the exclusive right to make, use, and vend the said invention," which is recited in Section 4884 of the Revised Statutes, is a heritage of the old idea that the grant conferred the right to use as well as the right to exclude others from using.

5. The patentee must be an inventor, and the patent must be granted for a limited period. This is because of the constitutional provision contained in Article 1, Section 8, which reads as follows:

"The Congress shall have power to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

Under this provision, Congress, if it undertakes to provide a patent system, must enact one which is primarily directed to rewarding inventors, and the only reward is to secure to them exclusive rights for limited periods. A system which is not characterized by these features is *dehors* the Constitution.

6. There is no statutory requirement that the patentee must be the first inventor. As between rival inventors the question of priority arises under Section 4904, which provides that where there are rival applicants, or an applicant for a patent to an invention already patented to another whose patent has not expired, the Office shall proceed "to determine the question of priority of invention." This phrase "priority of invention" occurs nowhere else in the statute. It is intended to cover only those cases where two parties are claiming the same thing as against the public. It is true that the applicant must swear that he believes himself to be the original and first inventor, but Section 4886 provides that any person who has invented something of patentable character may receive a patent upon due proceedings, provided that the thing was new when he invented it, and provided that he has not lost his right by delay. The language is too broad to warrant the statement that the applicant must be the original and first inventor; it is sufficient that the applicant be an independent inventor, that the original and first inventor is not contesting his right, and that knowledge of the invention was not available to the public before the applicant invented.

The legal definition, therefore, of a patent for an invention, is that it is a contract between a party claiming to be the inventor thereof and the Government, made in consideration of a disclosure of the invention by the claimant in his application, and proceedings taken as required by statute, and evidenced by letters patent conveying a grant by the Government to the inventor and his assigns, for a limited period, of the right to exclude all others from making, using, and selling the invention patented.

Motorcycles in the War

MOTORCYCLES are being found extremely useful in the war operations, especially for the transmission of dispatches, in which work they have proven superior to horse couriers. Another direction in which their utility has been found valuable is for use by the officer in charge of motor supply trains, as they enable him to keep in constant touch with the entire column. At the commencement of hostilities all of the nations involved seized all the motorcycles they could find, and since then heavy orders have been placed for more machines. Russia has recently placed orders in England for over sixteen hundred machines, distributed between six makers, all the machines that could be supplied within the specified date. This country has also made purchases in the United States, and it is reported that one manufacturer has booked an order for eight hundred machines as an instalment of a total order for twenty-five hundred; and another concern has made some large sales to Japan, and it is supposed these machines are to be passed on to Russia. Bicycles have not been overlooked, and it is said that already over two thousand have been sold to the European armies. Exact figures are not obtainable, as naturally American manufacturers are not anxious to make public their sales in these quarters.

The Current Supplement

THE current SUPPLEMENT of the SCIENTIFIC AMERICAN for November 28th, No. 2030, contains an article on the New York Fire Alarm System, by the Chief of the Bureau of Fire Alarm Telegraph, which should interest the dwellers in every city in the country, as it discloses a surprising condition of hopeless inefficiency in one of the vital branches of the machinery of a city that can easily exist almost anywhere when citizens fail to exercise proper supervision over their municipal affairs. A protective treatment of metals and an article on economical power from low grade fuels will be of great value to a host of practical people. There is also an illustrated article telling about the greatest irrigation dam in the country. Resistance to a ship's motion tells something about designing ships, and new ideas will be found in the discussion of the use of colors for signaling.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

English Armored Automobiles

To the Editor of the SCIENTIFIC AMERICAN:

In the article on "Armored Automobiles in War," published in the SCIENTIFIC AMERICAN of November 7th, my remarks on English armored cars are not correct, as in addition to Daimler trucks some touring cars have been fitted up with armor and quick-firers. The naval force sent to Antwerp included several of these.

London, England. JOHN JAY IDE.

The Muscular Machine

To the Editor of the SCIENTIFIC AMERICAN:

In Watt's method of measuring energy, he did not seem to make any distinction between energy produced by a motor and energy produced by muscular exertion, and I do not recall ever seeing in print any distinction made between them, and yet the difference can be demonstrated quite easily.

For instance: Should a motor raise 100 pounds 5 feet, we would regard it as 500 foot-pounds, even though it be raised in a second, minute, or hour; but should a 150-pound man consume one hour in raising (without apparatus) 100 pounds 5 feet in one continuous journey, he would produce only 500 foot-pounds, but completely exhaust himself, while it is quite obvious that he could, with much less exertion, walk up a hill 100 feet high in ten minutes, thereby producing 15,000 foot-pounds, or thirty times more energy than in the former case.

Again, should the man have placed in his arms 100 pounds, and attempt to hold it one hour, he would produce no work at all, but nevertheless would be required to exert great muscular energy to simply sustain the weight.

Another remarkable distinction is the fact that the animal or man consumes energy in descending a hill or stairway, while any inanimate machine gives forth energy in descending.

It would appear that the muscle, unlike any other form of motor, has a critical time to perform efficiently.

Riverton, N. J. CHARLES A. WRIGHT.

Ship Engine Control from the Bridge

To the Editor of the SCIENTIFIC AMERICAN:

In the synopsis of contents of SCIENTIFIC AMERICAN SUPPLEMENT No. 2022, published in October 3rd issue of SCIENTIFIC AMERICAN under subhead "Westinghouse Bridge Control," I note that an attempt is made by designers to control ship engines from the bridge. It is probably useless for one in my obscure position to attempt to criticise the scheme, but from my experience on and around lake and river boats, I should say that the idea is dangerous.

First, the captain or pilot as licensed by the Government is not required to know anything more about the operation of the engines than that one bell means stop; two, go astern; three, check; four, strong in direction at moment going; one also means start ahead if at rest. How to get these motions is not the thought of pilot, simply the results of said movements of propellers.

Inasmuch as the Government does not allow even the sole owner of a ship to navigate her, unless he has a license, but holds the regular pilot responsible for the safety of his ship as well as others, and stands back of him if he refuses to do the bidding of the owner, in case he sees danger in complying, how can the Government allow one licensed man to interfere with the work of another of their licensees?

There are oilers constantly passing through and around the engines when running and repairing and adjusting them when at rest, the Chadburn gong sounding in engine room gives engineer in charge notice of desires of pilot, and, if everything is clear, he complies with the order; the gong also warns others to get in the clear, and the position of throttle cut-off and reverse levers is such that the person moving same has a very clear view of moving parts and the platforms and ladders adjacent thereto.

The sudden starting or stopping of the cross-heads alone could easily mean death. How could the pilot know there was an oiler with his body foul of moving parts before he started up? What would he do if the engine took a good dose of water or lost the vacuum?

If the engineer in charge were to jump in and stop engines in such an event, might not the pilot be in a ticklish position in cramped waters and the ship, with others, endangered? This is the day of levers and push buttons, I must admit, but there is as yet great need of a mental clearing house every so often to examine the checks and see that no forgeries get by. Would suggest that this device be first tried out on a freight train, with the conductor handling the engine from the caboose. CHARLES M. GREEN.

Bedford, Ohio.

The "Foot-and-Mouth Disease"

A Scourge of Cattle Which Attacks Man

By Lewis W. Fetzer, Ph.D., M.D., of the Georgetown University Medical School

LIKE a clap of thunder and a bolt of lightning from a clear sky comes the announcement that foot-and-mouth disease is again with us. The announcement by the State Veterinarian of Illinois that the disease was prevalent among the cattle on exhibition at the National Dairy Show caused many to hold their breath and wonder what would be the fate of the valuable stock on exhibition.

This is not the first time that this pestilence has visited our shores, for we have had outbreaks from time to time, the last occurring in 1908. In 1908 and 1902 it was transmitted to us through the agency of the virus of cowpox imported from abroad and intended for the vaccination of human beings against smallpox.

The story of the 1908 outbreak is very succinctly told by the diagram taken from Circular 147 and also the 1908 Report, page 390, of the U. S. Bureau of Animal Industry. It appears at the time that the first intimation of the presence of the disease was in two carloads of cattle which were sent to Pennsylvania from the stockyards at Buffalo, N. Y. The source of the infection was finally traced to Detroit, Mich., where foot-and-mouth disease was present among twenty-one heifers previously used for the preparation of anti-smallpox vaccine. The outbreak of 1902 started in Chelsea, Mass., and is thought to have originated on the farm of a man who had a contract with a vaccine company to rent calves for the growing of cowpox virus. Later independent outbreaks were noted in other parts of Massachusetts.

The present outbreak is said to have its origin in Michigan and Indiana, and on October 19th the Secretary of Agriculture issued the Bureau of Animal Industry Order No. 220, which has the effect of preventing the shipment of cattle and their products out of these States. This order has been amended several times, and the quarantine at this writing includes the States of Michigan, Indiana, New York, Maryland, Illinois, Wisconsin, Iowa, Pennsylvania, Ohio, Massachusetts, Connecticut, Rhode Island, Delaware, New Jersey, Montana, and Kentucky.

This disease, known by various names, as aphthae epizooticae, eczema, epizootica, infectious aphtha, aphthous fever, Maul und Klauen Seuche (German), fièvre aphtheuse (French), etc., has been known from time immemorial and in many parts of the globe. The worst outbreaks have been in Europe, some of them in recent years.

Although attacking cattle principally, it affects hogs, goats and sheep, and next in order of susceptibility come the buffalo, American bison, camel, deer, chamois, llama, giraffe, and antelope. Young dogs and cats are especially susceptible to the infection, while guinea pigs and rabbits take the disease only exceptionally. Mice and poultry and older carnivorous animals are apparently immune. The horse and man sometimes become infected with it.

Foot-and-mouth disease is a very contagious and infectious malady which runs through an acute course and has as its essential feature the formation of blisters—vesicles, as they are called by the medical man—on the mucous membranes of the mouth and upon the skin between the toes (of cloven-footed animals) and around the coronets of the feet. Although these are the localities usually attacked, there may be other involvements, such as in the intestines and on the udder. The disease is most often ushered in with a chill which is followed by a fever. The fever, which may go as high as 106 deg. Fahr., subsides somewhat when the blisters make their appearance, which is usually in one or two days. The blisters, which contain a thin, yellow, highly contagious fluid, are at first the size of a hemp seed or pea, but they finally enlarge and often reach a silver dollar size. On maturity the blisters burst, discharge their fluid, and leave eroded raw surfaces which do not easily heal. In the course of the disease the animals lose their appetite, become very weak, and, in milch cows, the milk yield is seriously affected. The milk from these animals, especially those in advanced stages of the disease, becomes thin and often shows deposits of curd or a sediment composed of decomposition products and blood fibrin. The animals so affected cannot chew their food on account of the swollen condition of the lips and mouths. Veterinarians can easily detect animals affected with the disease by the smacking sound which they make with the lips and the ropy or stringy saliva which hangs from the mouth. Such animals when given water seek relief from the pain by playing around in the bucket with their snouts. The mucous membrane of the inner part of the lips and the gums of the teeth feel warm to the touch, and upon opening the mouths of these animals they show the characteristic blisters.

As a rule, all four feet of an animal are attacked, but it occasionally happens that only a part of them become diseased. The malady lasts for about ten to twenty days, but one attack of the disease does not always spare the animal from another. As remarked above, the contagious agent is contained in the fluid of the blisters. This fluid when discharged is cloudy and contains fine solid particles in suspension. Despite the fact that the disease has been known for a long time, very little is known about the exact nature of the infectious agent. To be sure, several investigators have come forward at various times and claimed that this or that micro-organism which they had isolated was the cause of the disease.

A similar history has yellow fever and hog cholera, but in none of these has the cause been shown by way of the microscope or cultivation on artificial media. The micro-organism, or what not, causing foot-and-mouth disease is so evasive that it passes through the finest pores of a porcelain or bisque filter which under ordinary conditions will filter out or retain such germs as the tubercle or typhoid bacillus. Consequently we must regard the cause as an ultra-visible and ultra-filterable virus which exists both in the lymph and blood.

It must be said, however, that the subject has been in controversy during the last three years, for it was Siegel, a German scientist, who presented evidence that the disease might be caused by globoid bodies—cytorrhyctes cocci—which often show an arrangement similar to the organism causing gonorrhea or spinal meningitis. These data were the subject of study by a commission appointed by the German government, but the results obtained in the laboratories of the Imperial Health Department at Berlin did not support Siegel's findings.

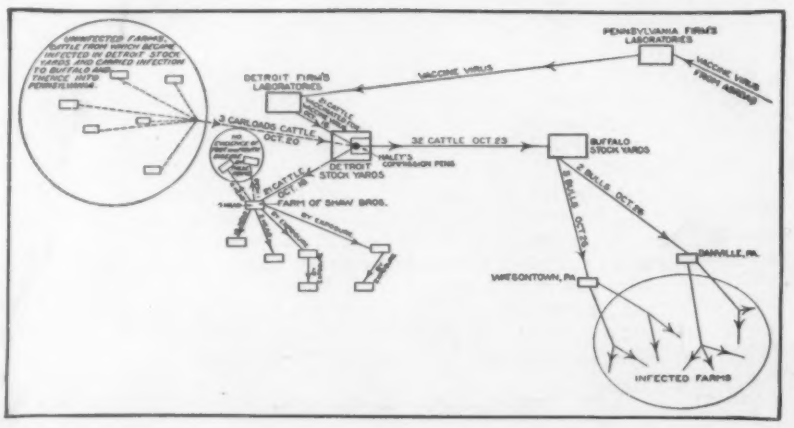
Like any other disease, this scourge may be transmitted by many avenues. If we stop to consider that 1/5,000 of a cubic centimeter of the lymph—blister or vesicle fluid—injected into a vein is sufficient to cause the disease, we can gain an idea as to the virulence of the same. Notwithstanding the high degree of virulence of this germ, it, like the tubercle bacillus, loses its potency when subjected to drying at ordinary temperatures and sunlight (within twenty-four hours). Strangely, when diluted 1:10 and kept in sealed tubes it retains its virulence for three to four months. When exposed to a temperature of 70 deg. Cent. (158 deg. Fahr.) for ten minutes, or heated to 100 deg. Cent. (212 deg. Fahr.), it is robbed of its infecting qualities. Repeated exposures to low temperatures, as —8 to —9 deg. Cent. (15.8 to 17.6 + deg. Fahr.), also destroys its virulence. It may also be destroyed by the well-known antiseptics, as carbolic acid, formaldehyde, hydrochloric acid, and soda solutions.

When the disease is present among animals kept in the same barn, field, or corral of the stock market, it is transmitted by contact with the saliva, vesicular fluid, or feces. Indirectly it is carried in the drinking water in troughs where diseased animals have drunk, in feed (hay, etc.), bedding, on the stall floor, animal transportation cars and boats, and in the pasture. Dogs, cats, fowl, and other birds are also dangerous mechanical carriers of the disease, and persons harboring these in regions where the disease is prevalent should make an effort to keep them confined until all danger is past. One of the greatest sources of danger in transmission is on the boots, shoes, clothing, and hands of persons who go from an infected barn to others where the disease does not exist. To prevent transmission through the agency of man, the officials of the U. S. Bureau of Animal Industry are provided with rubber coats, boots, hats and gloves, which may be easily disinfected before leaving an infected establishment.

Man may also become a victim of the disease. While this danger is more remote than it has been in years

Head of an infected cow.

Lesions on a diseased cow's feet.


UNINFECTED FARMS
CATTLE FROM WHICH BECAME INFECTED IN DETROIT STOCK YARDS AND CARRIED INFECTION TO BUFFALO AND THENCE INTO PENNSYLVANIA
PENNSYLVANIA FIRM'S LABORATORIES
VACCINE VIRUS
DETROIT FIRM'S LABORATORIES
2 CARLOADS CATTLE OCT 20
DETROIT STOCK YARDS
HALEY'S COMMISSION PENS
35 CATTLE OCT 23
BUFFALO STOCK YARDS
2 BULLS OCT 28
FARM OF SHAW BROS.
DANVILLE, PA.
WILLIAMSTOWN, Pa
INFECTED FARMS

How the foot-and-mouth disease was spread in 1908.

Photographs from the Bureau of Animal Industry

Inspector attired to prevent carrying contagion.

Method of disinfecting inspector with formalin gas.

back, when our knowledge of sanitation and methods of combating epidemics and epizootics was very limited and we had little or no Federal and State control of such outbreaks, there is still an opportunity for the disease to make some inroads on mankind. This is especially true with persons living in quarantined areas who consume raw milk and eat raw meats. There is absolutely no danger from milk which has been subjected to pasteurization or meat which has been subjected to partial or complete cooking. To say the least, we are assured by the U. S. Department of Agriculture that poultry is unusually free of the disease, and consequently we are safe as far as our Thanksgiving turkeys are concerned.

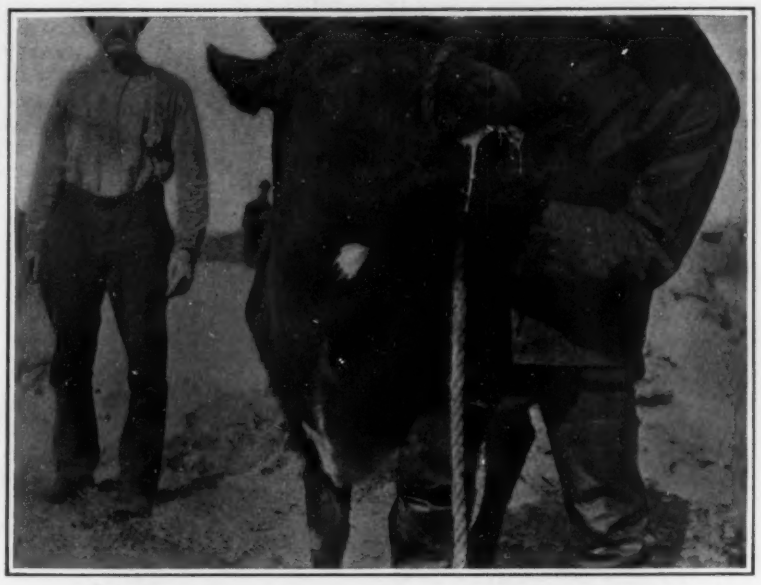
The persons very often affected are the help who work around animals and butchers. Veterinarians, dairymen, and others who work with sick cattle are often attacked on the borders of the nails, and occasionally a severe paronychia (whitlow or run-around) develops. A secondary infection by pus-producing organisms may follow such an attack. The disease in man resulting from drinking the milk of animals affected with foot-and-mouth disease usually makes itself apparent in two to ten days after taking the milk and sets in with a mild fever, which, however, may go as high as 104 deg. Fahr. This is accompanied by a shaking chill, loss of appetite, languor, pains in the muscles, back and head, and cramp-like pains in the abdomen. Nausea and vomiting may also occur.

The initial site of the disease is usually in the mouth, which feels hot and dry, and there are reddened spots over the lips, base of the gums, margin of the tongue, and mucous membrane of the cheeks. The blisters form in two or three days, after the first symptoms are noted, and, like in cattle, they tend to become large and confluent. The erosions and superficial ulcers which follow are painful to the touch. They may extend over the whole mucous membrane of the mouth cavity and into the pharynx, larynx, esophagus, and trachea. The blisters are quite often noted about the mouth and nose. The cornea and conjunctiva and the skin between the toes and fingers may also become involved. Again, as in cattle, the temperature falls with the appearance of the vesicles, and the mucous membrane of the mouth becomes swollen, making swallowing difficult. There is also a profuse salivation, pain in swallowing, and a nasal discharge. Fortunately the course of the disease in man, when uncomplicated, is mild and favorable. In children there may be inanition, diarrhea, and even bloody stools. The greatest danger with children is the severe gastro-intestinal inflammation which may occur.

As the immunity for this disease in cattle is a variable quantity, it is customary to kill animals affected with it and to destroy the carcasses by burning or burying after strong disinfection.

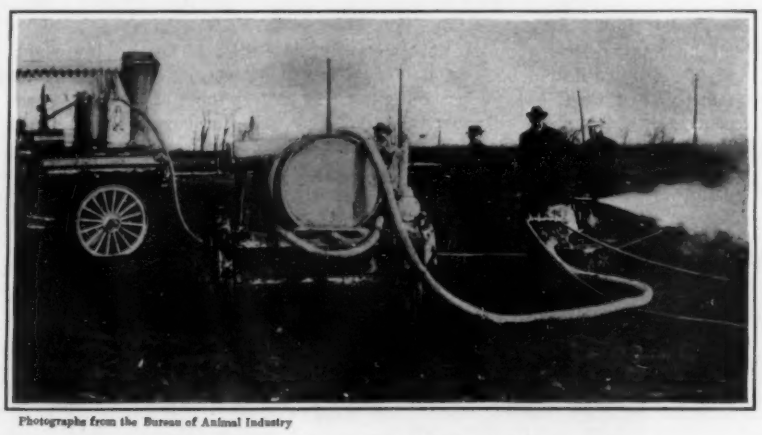
This is followed by strong disinfection of the premises by a squad of men specially trained in this kind of work.

If the fighting of the outbreaks of 1902 and 1908 is a measure of the Government and State officials' capacities for suppressing foot-and-mouth disease, we need have no fear as regards the favorable outcome of the present epizootic.



Examining a cow affected with the foot-and-mouth disease.

The slaughtered animals are buried under at least five feet of earth.



Photographs from the Bureau of Animal Industry

Disinfecting with a 5 per cent chlorinated lime solution.

Electricity in War

THE extent to which electricity has come to play a vitally engrossing part in modern warfare is yet but little realized outside of engineering circles. One of the most notable features of the conflict now being waged in Europe is the way in which information as to the movements of the contending armies has been transmitted. The leading factor in this important branch of military operation has been, of course, the aeroplane, which has done scouting and reconnaissance work besides fighting aerial duels on its own account, or patroling nightly the air over where the Kaiser is sleeping, to guard against the bomb-throwing aircraft of the enemy. Supplementing the operations of these machines is the work of the Intelligence Service, which by means of a remarkable instrument which slips into the pocket or can be strapped over the shoulder, can instantly establish telegraph or telephone communication between the fighting front and the division headquarters. The cavalry, compelled to move rapidly, have radio pack sets which are equally effective.

The use of various forms of light for signaling is rapidly extending. Aeroplanes are now fighting with light signal apparatus, which greatly increases their effectiveness in night scouting. When, some weeks ago, a Zeppelin was attacking Antwerp, the night was so dark that objects down below were not visible in the dirigible, but in the street were a group of spies with electric flashlights, and with these they signaled the aviators where their bombs were to be dropped. It was not long before the Belgians realized the trick and shot the spies, but in the meantime the bombs had done their work.

Another method of signaling now extensively used both for naval and military purposes is the searchlight, which is also invaluable for detecting hostile tricks at night. Its messages are sent by a flash code, the beam being raised or lowered or moving to the right or left, projected into the clear air or on a cloud, as the case may be. It is also an effective means of communication between an army or a fleet or a belligerent garrison.

In view of the prominence which the submarine has recently assumed, the new Fessenden submarine signaling device described a few weeks ago in the SCIENTIFIC AMERICAN is attracting much attention. It consists of an electric oscillator, which when attached to the inner skin of a ship sends out a tone that can be heard on board another vessel five to thirty miles away. This signal tells of approaching ships or icebergs. By its use nearly all the terrible marine disasters of the past two years might have been averted. It is believed that some of the European submarines are already equipped with it. Inventors are hard at work on methods of increasing the efficiency of the submarine. A leading American constructor is said to have turned over to the Germans a device by which a submarine can run along the enemy's coast and send out devices to cut the cables of the mines guarding the naval bases, pass into those bases submerged, and torpedo the hostile warcraft at anchor within harbors where it was supposed to be safe, behind mine fields and fortifications. When it is remembered that the submarine can now carry enough fuel to travel more than 450 miles on the surface, and when operating submerged at a speed of 5 knots, can cover fully a hundred miles, the rapidly augmented importance which recently attaches to its war operations is easily understood.

As indicating the immense value of electricity on board battleships, in a recent installation there were 3,000 electric lamps, motors having an aggregate rating of 4,000 horse-power, and approximately 76 miles of cable. By electricity the captain transmits his orders as to the speed of the propellers, the position of the rudder, the course of the vessel, and the range of the enemy, as well as his instructions as to the handling of the guns. Each turret and group of guns has its own local system of interior communication, electrical or mechanical. The ship's dynamos, steam driven, are the primary source of electric power, though storage and other batteries are used to a limited extent. A special problem on board ship is the illumination of the cross-wires of telescopic gunsights, to enable the gun pointers to aim at night. This is done by the diffused light from the searchlight used to illuminate the target. In cases where this is not practicable, miniature lamps are kept ready for night sighting. There are also special problems in telephony to be dealt with. One of these is the providing of a transmitter which will operate in any position, which the ordinary carbon transmitter will not do. Loud speaking telephones or megaphones are used for "paging," for calling away boats, and transmitting information of various kinds. The bugler blows into the megaphone transmitter the call for any particular boat, or the messenger calls for the electrician in charge of a special department, and thus saves the endless and wearisome climbing of ladders which was formerly involved.

Frederick L. Goss Dies

FREDERICK LLEWELLYN GOSS, one of the inventors of the well-known printing presses that bear his name, died at his home in Chicago on November 10th, at the age of sixty-seven years. Mr. Goss was of English parentage, but was born in Wales. Coming to this country when quite young, he entered the printing business of the J. M. W. Jones Company in Chicago, where he soon reached the position of superintendent, acquiring, in the meantime, a thorough knowledge of the business. With his brother Samuel he invented the press that has carried his name into many of the largest neswpaper plants in the country, and they formed the Goss Printing Press Company, of which he was long vice-president.

An Unfailing Reminder.—Among useful inventions which are brought out by a Paris firm is noted a handy little device in the way of a memorandum tablet which serves as a reminder of engagements or the like. It consists of a small celluloid tag which has a spring clip to attach it to a watch. The tag is fastened to the watch stem in such a way that it covers the face of the watch and thus cannot fail to be seen by the wearer. The pencil notes can be readily effaced.

The Heavens in December

The Heat We Receive from the Stars

By Henry Norris Russell, Ph.D.

IT has long been a question of much interest whether we receive heat from the stars, and, if so, how much. The first half of the query was answered in the affirmative, from the theoretical standpoint, long ago. The stars send us light, of the same nature as that which we receive from the Sun; the Sun's light carries energy with it, which appears as heat in the bodies upon which its rays fall; and hence a certain amount of energy must be brought us from the stars, and their radiation must have a heating effect, though an excessively small one. Even for the brightest of all stars, this should, however, be not more than one ten-thousand-millionth of the heating effect of direct sunlight, or about a hundred-thousandth part of that of the light of the full Moon. It is not surprising, therefore, that until recent years all attempts to detect and measure these almost infinitesimal amounts of energy met with no success.

About fourteen years ago Prof. Nichols, working with the two-foot reflector of the Yerkes Observatory, secured the first unquestionable direct evidence of heat-radiation from the stars; but, even with the most sensitive detecting apparatus that could be devised, it was only possible to make observations on a few of the very brightest stars. He found, however, that stars which look equally bright to the eye may send us different amounts of radiant energy, for Arcturus, which looks to the eye very nearly equal in brightness to Vega, produced more than twice as great a deflection as Vega upon the scale of his apparatus.

No very great advance was made in this very difficult field until the present year, when Dr. Coblentz, of the Bureau of Standards in Washington, reported upon his summer's work at the Lick Observatory, whither he had gone to attack this very problem. How great a stride forward his work represents can be seen at once when it is realized that his apparatus will give distinct indications of the heat received from stars so faint as to be invisible to the naked eye. It is perhaps a hundred times as sensitive as some of the earlier ones.

To have any chance of success it is, of course, necessary to concentrate the light of the stars as strongly as possible, by means of a large telescope; and a reflecting telescope must be used, for the glass of a lens, though transparent to ordinary light, cuts off a great part of the radiations of longer wave-length which carry much of the energy.

Dr. Coblentz had the good fortune to have the 36-inch Crossley reflector put at his disposal; but, even with this powerful instrument, his success is mainly due to the very delicate heat-measuring apparatus which he devised.

Like a number of other appliances with which brilliant advances in observational work have recently been made, this is essentially very simple, being a "thermo-element" composed of fine wires of bismuth and platinum, joined at the tip, which is expanded into a little disk 1/60 of an inch in diameter, and blackened to make it a good absorber of heat. When the star's rays fall upon this junction of the two wires it is very slightly heated, and this sets up a thermo-electric current in a circuit of which the wires form a part, and causes a deflection of a sensitive galvanometer.

To protect the thermo-element against changes of temperature and other disturbances, it was hermetically sealed in a glass receptacle which was exhausted to a very high vacuum. A window for the admission of the light of the stars, cemented upon one side of this receptacle, was made of fluorite, the most transparent material for the long heat-waves.

Using a galvanometer of the sensitiveness "usually employed at the Bureau of Standards" (in such delicate work) it was possible to obtain the amazing results already briefly described.

The radiation from more than a hundred celestial objects was measured, and the results, themselves of the highest interest, open up an entire new field of investigation.

The most important feature of the observations was the comparison of pairs of stars of about the same brightness to the eye, but differing in color and spectral class, and close together in the sky, so that the influence of the absorption of their radiation in our atmosphere was the same. It was invariably found that for the same visual brightness, a yellow star sends us more heat than a white one, and a red star more than a yellow. Speaking roughly, Dr. Coblentz declares a yellow star of spectrum like the Sun gives out twice as much energy or "heat" in proportion to its light as does a white star like Vega or Spica; while a red star like Antares radiates three times as much heat as a white one of the same apparent brightness.

Certain exceedingly red stars—notably the star 19 Piscium, which is typical of a peculiar class whose spectra are denoted at Harvard by the letter *N*—give out twice as much heat in proportion to their light as the ordinary red stars do.

It may be surprising at first sight to read that these facts strongly confirm the accepted theory that the whitest stars are the hottest and the reddest the coolest; but a little consideration will show that this is really so, and that the hottest stars will give out the least heat in proportion to their light, or, reversing the proposition, the most light for a given radiation of heat. If we heat a body to a temperature a little below 500 deg. Cent. (or 900 deg. Fahr.) it will be just short of a "visible red heat"; that is, while freely radiating energy at a considerable rate, as we may assure ourselves by bringing our hands near it, it sends out no light at all.

Heat it a little hotter, and it begins to glow with a faint red light, but it light-emission, in proportion to its heat, is very small. As its temperature rises, it will steadily emit more light and more heat; but the increase of luminosity will far outrun that of heat radiation, so that its "luminous efficiency," from the engineering standpoint, will rapidly increase. At the same time the proportion of light of the shorter wave-lengths —green, blue, and violet—in its visible radiation will increase, giving rise to the familiar change in color from red through yellow to white.

A practical illustration of these principles is the well-known efficiency of the tungsten lamp, which, for the same consumption of electrical energy (and hence, radiation of heat) gives some three times as much light as an old-fashioned carbon lamp. This is explained entirely by the fact that the working temperature of the tungsten filament is several hundred degrees higher than that of the carbon.

It is well known to illuminating engineers that even the highest temperatures which known materials will endure without volatilizing fall far short of those at which the luminous efficiency would be the greatest.

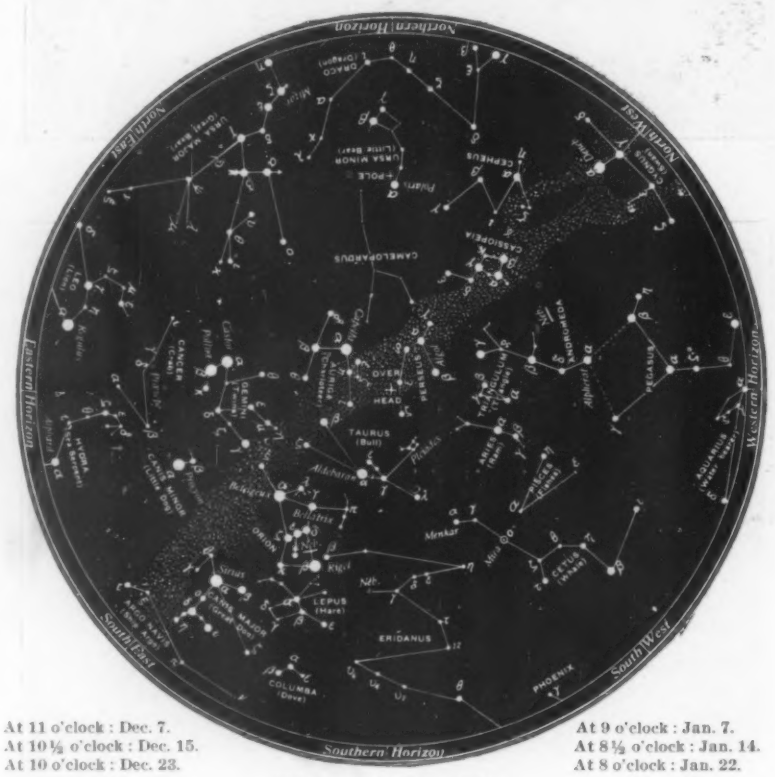
The stars begin about where terrestrial light-sources leave off. The very red stars of spectrum *N* are not improbably cooler (on their surfaces) than the tungsten filament. Such stars as Antares are probably a little hotter than the safe working temperature of a tungsten lamp; and so the scale of temperature rises past that of the Sun, to the white stars, and the luminous efficiency rises with it, just as Dr. Coblentz has found.

He has added a direct proof of this in a simple and elegant way, by interposing, at times, in front of his apparatus a cell containing a layer of water one centimeter thick. This water, though transparent for all the visible rays, is opaque to all those whose wave-lengths are twice as long as that of red light, and hence, to the greater part of the "obscure heat" radiated by bodies at moderate incandescence.

Tests on various stars showed that the water cell absorbed about 35 per cent of the radiation from white stars, such as Vega and Altair; 50 per cent of that from stars of the solar type, like Capella, and 75 per cent of that from red stars like Antares. This is as convincing a proof as could be wished that the reddest stars have the lowest temperature.

The possibilities of future observation opened by Dr. Coblentz's work are almost unlimited. The investigations so far made were only preliminary, and no attempt was made to push the sensitiveness of the galvanometer to the highest attainable limit. If this was done, and if the apparatus could be attached to the 100-inch telescope at Mount Wilson when this is completed, a sensitiveness probably twenty, or even fifty, times greater than the present could be attained, and it would be possible not only to measure the energy radiated from stars of the ninth or tenth magnitude, but to analyze the radiation of the brighter stars, and find its exact distribution among the various wave-lengths.

It would then be possible to estimate their temperatures with considerable accuracy, as can now be done in the case of the Sun. Such estimates can be made even now; but the far more extensive data which would result from observations of the kind here considered would give the results greater precision, and throw a great deal of light on the physical conditions prevailing upon the stellar surfaces.



At 11 o'clock : Dec. 7.
At 10½ o'clock : Dec. 15.
At 10 o'clock : Dec. 23.

At 9 o'clock : Jan. 7.
At 8½ o'clock : Jan. 14.
At 8 o'clock : Jan. 22.

At 9½ o'clock : December 30.

NIGHT SKY: DECEMBER AND JANUARY

The Heavens.

Our map shows the winter skies in all their splendor, as they would appear to an observer lying on his back and holding the map above his head. The finest part of the sky is in the southeast. In little more than one quarter of the visible hemisphere we find nine stars of the first magnitude—Capella, almost overhead; Castor and Pollux, close together in the east; Regulus, just rising below them; Procyon, to the right of Castor and Pollux, and a little lower down; Aldebaran, high in the southeast; Rigel and Betelgeux, below Aldebaran, at opposite sides of Orion, and the brilliant Sirius, low in the southeast, but far outshining all the others.

In the northeastern quarter there is but one conspicuous group, the Great Bear, low down near the horizon; while in the northwest the finest constellations are Perseus, Cassiopeia and Cygnus, in the Milky Way, the last setting. Pegasus and Andromeda are conspicuous in the west, but the southwest contains, in Eridanus and Cetus, the two biggest and dullest constellations in our skies.

The Planets.

Mercury is morning star throughout the month, and is best visible at its beginning, when he rises about 5:40 A. M. Being north of the Sun, he should be easily visible, appearing like a very bright star, brighter even than Arcturus. On the 15th he rises at 6:30, and he will not be easy to see after this date.

Venus, too, is a morning star, close to the Sun at the beginning of the month, but rapidly coming out into a favorable position. On the 7th, at 10 A. M., she is in conjunction with Mercury, being but 21 minutes of arc south of him (two thirds of the Moon's apparent diameter), and in the same field with a low-power telescope. The two planets should present a beautiful and interesting sight that morning before daybreak.

By the end of the month Venus rises at 4:15 A. M. and is extremely conspicuous. Mars is in conjunction

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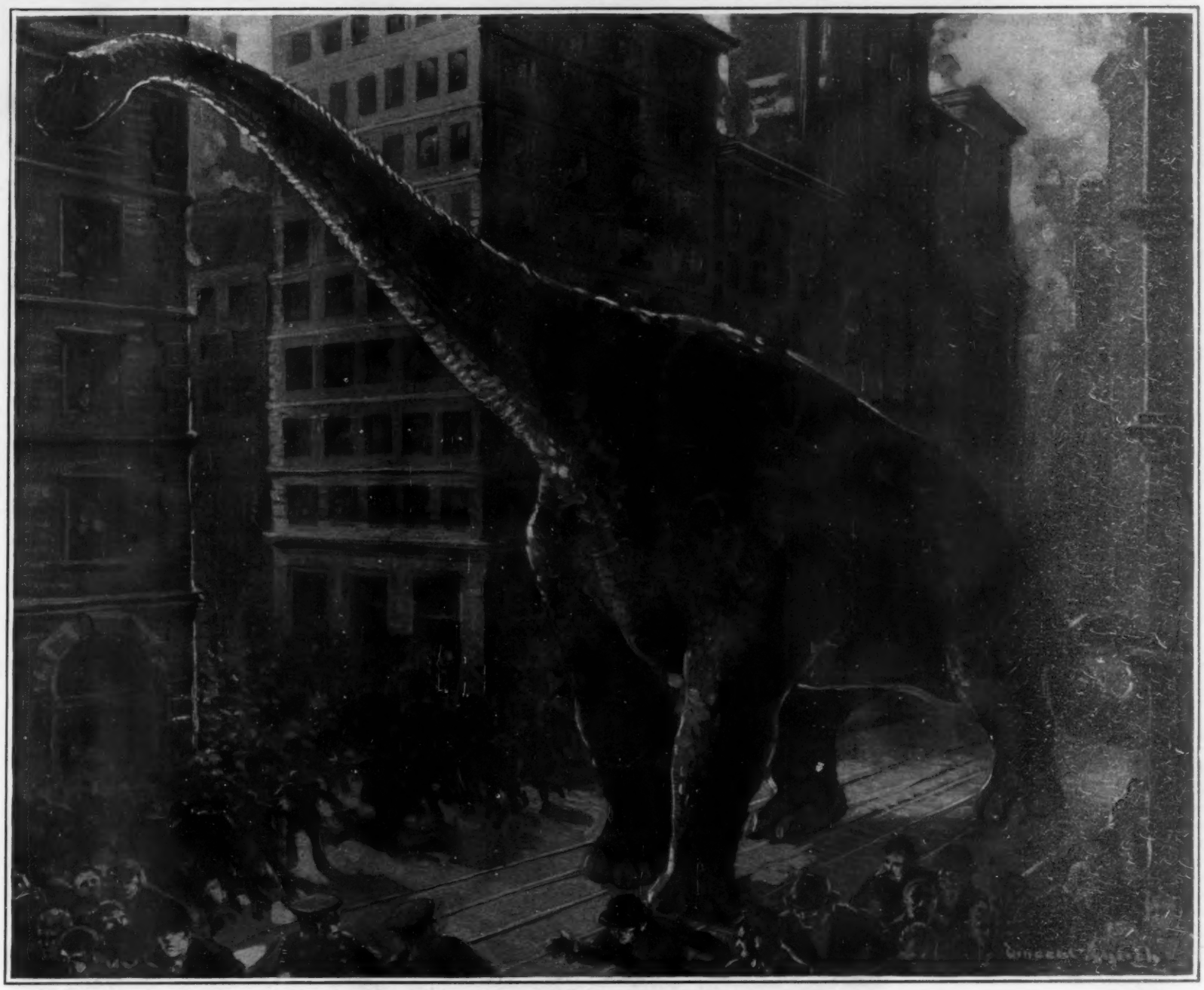


If Gigantosaurus had lived in the twentieth century instead of many million years ago, if he had been a land animal instead of an aquatic creature, and if he could be made to walk up Broadway, New York, the effect would be that which we have shown. Since the creature stood over twenty feet high at the shoulder and had a neck estimated at thirty-six feet long, he could easily have looked over the tops of most houses. The picture is intended to show how enormous Gigantosaurus was, and is not to be regarded as a representation of his habits.

The Largest Known Dinosaur

A Huge Extinct Reptile from German East Africa, the Largest Known Quadruped

By Dr. W. D. Matthew, American Museum of Natural History

IN his "Discovery of America," Fiske points out that the discovery of a new continent, the unveiling of its form and outlines, and placing it correctly on the map, was not a matter of a day or a year. Rather was it a slow continuous progress of successive explorations extending over several generations, each new step adding a little to that geographic knowledge which was far from complete even a century after the death of Columbus.

So, too, is it with the discoveries of extinct animals. Between the time when the first explorer stumbles over a fossil limb bone weathered out and exposed on the surface to the attacks of sun and rain, and the final unveiling of the monster skeleton in a great museum, years must elapse; years of diligent work in excavating, transporting, preparing, articulating and mounting the bones, in restoring the missing fragments, studying the habits, environment, and affinities of the animal and deducing its probable form, and finally in publishing the well considered conclusions.

It is difficult for the layman to make fair allowance for these delays. He sees perhaps a newspaper report of the wonderful new discoveries made by some scientific expedition, and looks forward on his next visit to the museum to seeing the great skeletons installed in its halls. Instead, he is informed that they are "not yet prepared," and for years he hears nothing further. He is very apt to conclude that the report was only a newspaper tale, and to take but little stock in such stories; to discount them all as mainly "hot air."

Perhaps the same skepticism has been rather generally visited on the reports of marvelous finds of dinosaurs in German East Africa by the great expedition from the Berlin Museum. The prodigious skeleton, 130 to 150 feet long, that appeared in the various newspaper illustrations a year or two ago, has not been installed for public view; only two or three of the huge limb bones have as yet appeared. And when it does appear, the proportions and construction are likely to differ as widely from the preliminary sketches as do the modern maps of North America from the strange-looking outlines of a fifteenth century map.

The official report of the results thus far attained by the Tendagurn expedition of the Berlin Museum has just been issued. It contains reports of the field work and of the progress up to date in the preparation and scientific research upon the collections secured, by Director Branca and Curator Janesch of the Berlin Museum. Concerning the Gigantosaurus skeleton, the most interesting of the many important finds made by the expedition, the following data are now available.

The principal specimen is a skeleton lacking the tail and parts of the hind legs, but believed to be otherwise practically complete. The missing parts are mostly supplemented by other specimens referred to the same species, so that it will be possible to mount a complete skeleton in the Berlin Museum.

It belongs to the group of Sauropoda or Amphibious Dinosaurs, the Giant Dinosaurs *par excellence*. It is distinguished from the Brontosaurus or Diplodocus by the huge proportions of the fore limbs, enormous length of neck, and greater depth of the body. The humerus or upper limb bone is 2.10 meters (6 feet 8 inches) long, as against 4 feet in Brontosaurus and three in Diplodocus; the lower limb is 1.30 meters (4 feet 4 inches); the longest foot bone, 61 centimeters (2 feet); the middle ribs are over eight feet long. The length of the longest neck vertebra is given as 1.20 meters (nearly four feet); there appears, however, to be some doubt attaching to this measurement, as also to the calculated length of neck of 36 feet. There is no question, however, that it was much longer than in Diplodocus.

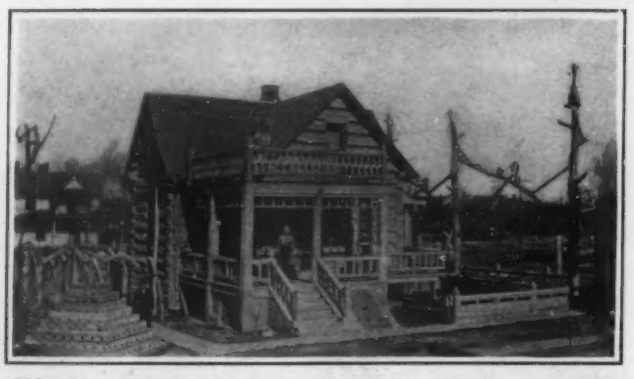
The animal is now recognized by the Berlin scientists as belonging to the same genus as a partial skeleton discovered in Colorado in 1902 by E. S. Riggs of the Field Museum in Chicago, and described by him as Brachiosaurus. The size and proportions agree quite closely, as was pointed out in *Science* by Dr. F. A. Lucas when the first announcements of the German discoveries were published. Brachiosaurus, therefore, is the proper name of the animal, unless indeed it shall turn out to be identical with a still earlier discovery announced by Prof. Marsh under the name of Barosaurus.

From the measurements and figures given by the Berlin authorities, combined with those of the Brachiosaurus described by Mr. Riggs, I have ventured upon a sketch reconstruction of the entire skeleton, using as a guide the proportions and articulation of the well-known skeletons of Brontosaurus and Diplodocus which have been mounted in the museums of New York, Pittsburgh, and Frankfurt-a-M. While this preliminary

(Concluded on page 446)

A tangle of cement trees with weird allegorical figures.

The cement figure of the Devil.



Side view of the house, showing the cement strawberry mound.

"Garden of Eden" in Cement

ONE of the oddest homes in this country, if not in the world, is to be found in Lucas, Kansas. The old gentleman who owns this home has aimed to reproduce the original Garden of Eden in cement. The house is of the log cabin style, and is built of stone logs, some of which are twenty feet long. The porches, walks, fence, and trees are all made of cement, no wood whatever being used. Near the cabin the owner has built a cement mound for a strawberry bed. The plants grow from holes in the sides. Forty-two tons of cement were used in the construction of this "Garden of Eden."

As the visitor enters the front gate he sees Adam and Eve with arched arms over the walk, and Eve handing an apple to Adam. An immense serpent is twined on one of the trees watching the apple transaction. There are seven cement trees from 30 to 38 feet high and twelve others from 8 to 15 feet high.

On one of the corner trees is to be seen Cain and his wife, and on the next tree Abel (dead) and his wife, while a dog is in an angle of the tree. In one tree is the "All-seeing Eye and Hand," while in another Cain and Abel may be seen making their offering (pumpkin and sheep), while near by are two girls. To the right of the girls are two storks roosting, and back of them is the figure of the Devil. The Devil measures 8 feet in height. He is holding his tail with one hand and a fork with another.

The place presents a weird appearance at night when lighted up, as the owner has installed electric lights in the mouths of the various animals.

If the Garden of Eden really looked as horrible as this we cannot understand why it was necessary to place an angel with flaming sword before it to keep out trespassers.

Largest Bank Vault Door in the World

AN enormous door of armor plate has recently been completed at South Bethlehem, Pennsylvania, for the largest bank vault in the world. It will be placed in the new J. P. Morgan building, at Broad and Wall streets, New York. It has taken a year to build the door at a cost of $75,000, and the vault to which it will be attached will cost $200,000. The door and vestibule attached to it weigh 120 tons. The vault will be three stories high. Despite its enormous size, the door has been so accurately constructed that when closed it will make an airtight and watertight joint. Being constructed of solid armor plate a burglar will find it an exceedingly difficult matter to make any impression upon it.

The vestibule of the door is 11 feet 6 inches in diameter, and the door itself 9 feet in diameter, with a thickness of 45½ inches. It is controlled by two 5-inch bolts, which in turn are controlled by two combination locks, and these by a time lock with four movements, so arranged that any one of these movements will permit the opening of the combination lock.

The door swings on a crane hinge with heavy pressure mechanisms to force it to its seat and to make the joint tight. This prevents the introduction of any explosive of a liquid nature. The door, vestibule, and vault are constructed of Harveyized nickel armor plate. These plates are made of the full thickness, and are not held together by screws or bolts, but are dovetailed on the inner edges. After being fitted tightly together wedges are driven on the inside to hold the plates solidly to their place.

A 100 horse-power tractor hauling a twenty-four bottom plow.

A 100 Horse-power Tractor

THERE were 30,000 people in attendance at the Power Farming Demonstration at Fremont, Nebraska, this year. They came from twenty-seven different States and were practically all farmers who were interested in power farming, as is shown by the fact that tractors were sold on the grounds into fifteen different States.

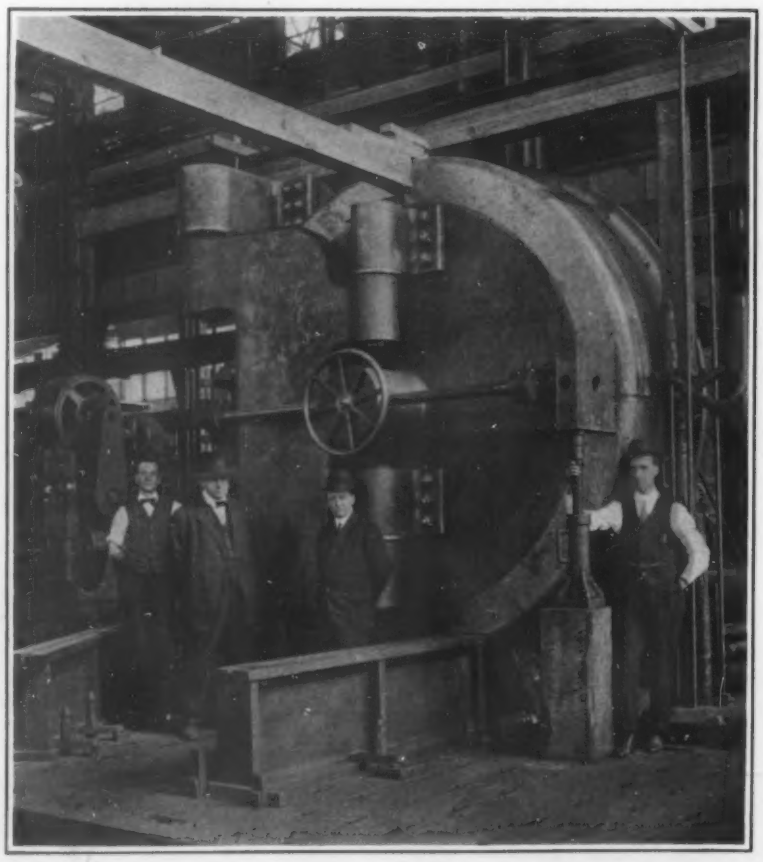
The smallest plow on the grounds was a two bottom, and the largest was a twenty-four bottom 14-inch plow. This was used with the big 100 horse-power tractor, which is the property of the Austrian government, but which the manufacturers are unable to deliver on account of the war.

The amount of horse-power that could be exerted by all the machines on the demonstration grounds at one time was 1,000. With the plows they pulled, these machines were capable of plowing in one 10-hour day 750 acres, 8 inches deep.

Goat-skin water-bottles in the market at Hebron, Palestine.

An Oriental Water-bottle Market

HEBRON, one of the oldest cities in Palestine, has always been famous for its Oriental water-bottles, made of goat skins. Here are to be found large tanneries where these receptacles are turned out by the thousand, and our photograph depicts what is called the "water-makers' market," which is situated to the east of the ancient city. Lying upon the ground in rows may be seen hundreds of goat skins awaiting purchasers. Each skin is inflated, either with water or with air, so that the buyer may know it is perfectly water-tight. The majority of the skins used come from Arabia, while a large number are also received from the Lebanons. They are brought to Hebron by the camel caravans, and are purchased by the tanneries and turned into bottles. They pass through many processes, and a tanner will spend a week upon a single skin before it is rendered water-tight and serviceable. From Hebron these old "bottles" are sent to all parts of the East, thousands going down into Egypt and the Soudan every year. They are also used as rafts. A number of inflated skins are attached to a light wooden frame, which then not only readily floats, but is capable of carrying quite a heavy load. Such craft are to be seen upon the rivers of Syria, and also upon the Euphrates and Tigris.



Enormous vault door that took a year to build.

Adverse Decisions in Interference.—A new practice has been established in connection with interferences involving letters patents. If in such interference a decision is rendered adverse to the patentee, there is printed in the Official Gazette of the Patent Office a note to the effect that on the date given a decision was rendered that the patentee was not the first inventor of the subject matter covered by certain claims or claim specified of his patent, by number, and that no appeal having been taken within the time allowed, such decision had become final.

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(*Concluded from page 436.*)

who had charge of this apparatus, reported that it was invaluable in enabling him to get pure water for washing wounds, and that he had not had a single case of operatory infection since using the water thus sterilized. The Austrians have also been using a field sterilizer of this kind during the past few years. The accompanying illustration shows the manner of equipment at the present day in the Austrian army. This consists of an artillery car on which is mounted a small gasoline motor generator set of about 2½ horse-power, a water pump, a filter, and an ultra-violet ray sterilizer. The body weight of the entire outfit is about 2,000 pounds. When in use a hose 15 to 20 feet in length connects the pump with the source of supply. The water is then pumped through the filter to the sterilizer, which is placed outside of the wagon, on a folding tripod. Six spigots are supplied so that a number of men can fill their pots or canteens at once.

The great advantage of this method is that the apparatus can begin delivering sterile water within ten minutes of starting the gasoline set, and less than this time is required to pack up the outfit and move to another water supply. One man alone without any great technical knowledge can operate this outfit. This type of army sterilizer has been submitted to elaborate maneuvers, in addition to very rigid army tests, and has given remarkable satisfaction and service.

Thus the germicidal properties of ultra-violet rays are applied in assuring an army sterile water, both for drinking and surgical purposes.

The Loss of the "Audacious"

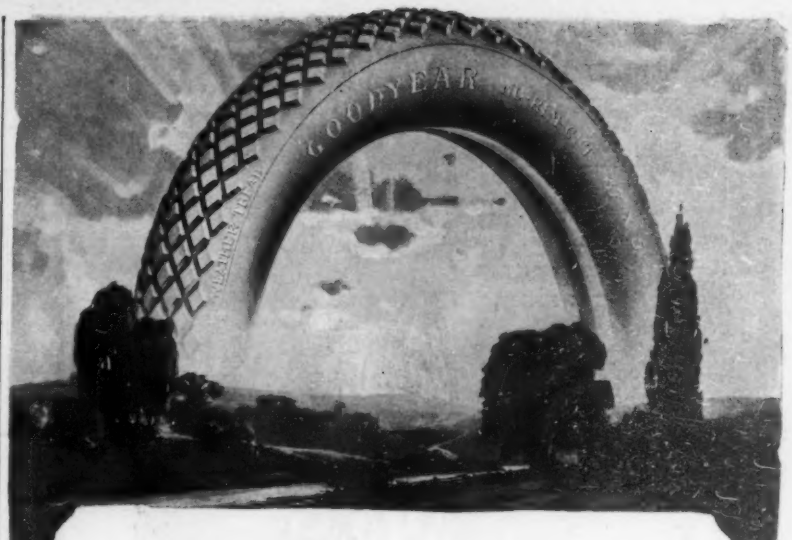
(*Concluded from page 437.*)

the menace of mines and submarines, the British battleship fleets are probably gathered at certain bases on the North Sea coasts of England and Scotland, where they are thoroughly protected by mine fields. Here they are in touch with the scouts, protected cruisers, destroyers, etc., which are patroling the German coasts and the entrance to the Baltic, ready to flash the news to the main fleet, should the Germans attempt a sortie.

How then, it will be asked, did it happen that the "Audacious" was on the northerly coast of Ireland, and what was she doing there, so far from the North Sea blockade. The answer is to be found in the necessity for keeping the gunners tuned up to their work by target practice. Target practice must be done in the open sea, and involves steaming over considerable distances. Obviously the submarine-infested waters of the North Sea, mine-strewn as they are, involved too great a risk; and hence, the Admiralty selected for practice grounds, waters remote from the North Sea.

Lough Swilly, near which the disaster occurred, is a naval base, and the "Audacious," at the time of the accident, was about twenty miles off shore, and was just turning to make her run past the target. She is stated to have been in squadron formation with four other ships. From this we infer that the ships have been sent away from the North Sea, a squadron at a time, for battle practice in supposedly safe waters.

The fact that the "Audacious" was struck aft on the port quarter, near the engine room, has led to the suggestion that the blow was that of a torpedo, fired from a submarine—this for the supposed reason that, if a ship runs against a mine, she must necessarily strike it head on and be damaged in the forward portion of the hull. But the ship was turning to make the run past the target. This turn is made with the helm well over, and under these conditions the ship pivots sharply about her stem, the stern swinging over to port or starboard (to port in this case). There is a marked lateral movement of the ship during the turn, and the bow might clear a mine which the after portion of the ship would override. This is what happened to the "Audacious."



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To the naval constructor, the most staggering fact is that a single mine should have sent so modern a battleship to the bottom. Such ships as the "Audacious," the "New York," the "Kaiser," were believed to be so thoroughly subdivided as to be capable of taking the blow of two or even three torpedoes without foundering. Perhaps they could, if the torpedoes were of the older patterns, carrying from 100 to 150 pounds of high explosive; but the latest torpedoes carry between 250 and 300 pounds, and a mine may carry 500 pounds.

The Germans are doing everything on a big scale in this war, and it would be like them to make their mines of the most deadly character. The destructive energy of a mine increases as the cube of its charge. A 500-pound mine would let loose within a ship a volume of gases at high pressure that might so wrench the whole internal structure in the neighborhood of the blow as to set up a slow leakage that would gradually, as in the case of the "Audacious," destroy all her buoyancy.

The "Audacious," completed last year, was of 23,000 tons and 21½ knots speed. She mounted ten 13.5-inch guns in five center-line turrets and a torpedo battery of sixteen 4-inch guns. Her side armor was 12 inches at the waterline, decreasing to 7 inches at the main deck. Her complement of officers and men was 900.

Our illustration, taken from the deck of the Olympic, while her boats were taking off the crew, shows the ship, down by the stern, with a marked list to port. It will be noted that she is stripped for battle practice, the rails being down and the ensign (the ensign flagpole having been unshipped from the stern) being flown from a pole on the starboard side of the after bridge.

The Heavens in December

(*Concluded from page 442.*)

with the Sun on the 16th, and is invisible this month.

Jupiter is evening star in Capricornus, setting about 9:40 P. M. on the 1st and 8:10 on the 31st, and is the brightest object in the evening sky.

Saturn is in opposition on the 21st and is visible all night long. He is in Gemini, at his greatest northern declination, and splendidly placed for observation. His rings are opened out at their widest angle, and he appears to the naked eye even brighter than Capella, and is excelled only by Sirius.

Uranus is evening star in Capricornus, too low in the west to be comfortably seen.

Neptune is in Cancer, approaching opposition, his position being 8 hours 9 minutes 16 seconds, plus 19 degrees 43 minutes on the 3rd, and 8 hours 6 minutes 46 seconds, plus 19 degrees 52 minutes on the 31st.

The Moon is full at 1 P. M. on the 2nd, in her last quarter at 7 A. M. on the 10th, new at 10 P. M. on the 16th, and in her first quarter at 3 A. M. on the 24th.

She is nearest us on the 15th and farthest away on the 27th. In her circuit of the sky she passes near Saturn on the 4th, Neptune on the 6th, Venus on the 15th, Mercury on the 16th, Mars on the 17th, Uranus and Jupiter on the 20th, and with Saturn once more on the 31st. The conjunction with Jupiter, which occurs at 8 P. M. on the 20th, is very close.

At 11:15 A. M., by Washington time, on the 22nd the Sun reaches his greatest southern declination, and, in the almanac phrase, "winter commences."

Princeton University Observatory.

The Largest Known Dinosaur

(*Concluded from page 443.*)

reconstruction will doubtless have to be modified to some extent when the preparation and mounting of the Berlin skeleton is completed, which may not be for some years to come, yet it serves to show approximately the gigantic proportions of the animal, its extraordinary length of fore limbs and neck, and the great depth of body. The tail seems to have been much shorter than in Diplodocus and Brontosaurus. The huge size is shown by

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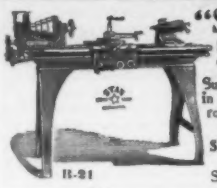

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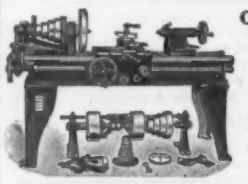

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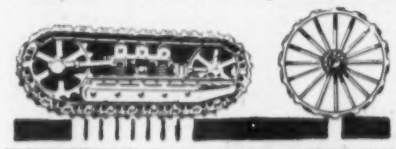

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contrast with the outlines of the Imperial Mammoth, the largest of the American mammoths, and with a man of average height. One group only of living animals, the whales, equal or surpass the Brachiosaurus in bulk. No four-footed animal, living or extinct, can equal it. It lived about the beginning of the Cretaceous period, contemporary with its American relatives; but while these inhabited the fresh-water lakes and bayous which then extended along what are now the flanks of the Rocky Mountains, the remains of the African species are found in salt-water formations deposited in the coast swamps and protected inlets along the old East African shores.

The Berlin authorities believe that the animal was amphibious. I have advocated the view (propounded many years ago by Owen and Cope) that these so-called Amphibious Dinosaurs were really entirely aquatic, necessarily so because of their gigantic size, which would make it a physical impossibility for them to emerge entirely on dry land. The larger an animal is, the less is the strength of his muscles relative to their weight, a corollary of the well-known mechanical law that the strength of a beam varies as its cross-section, the weight as its bulk. As long as these animals were in the water their weight would be largely buoyed up, and they could attain, like the living whales and various extinct sea-monsters, a size that is impracticable for a terrestrial animal. Thus, too, they would be out of reach of the great carnivorous dinosaurs of the land, against whose attacks they had apparently no such means of self-defense as the land dinosaurs possessed. It is, of course, obvious that they were adapted for wading on the bottom, not for swimming, although no doubt they could swim as well.

According to this theory, the Gigantosaurus acquired his huge forequarters and long neck in adaptation to living in deeper waters than his relatives. While the gigantic dinosaurs of this country are found in fresh-water formations, this animal probably lived in an environment such as may be found to-day in the series of bays and inlets along our South Atlantic coast from New York to Florida. Here he could wade about in the shallower waters, feeding upon the luxuriant tropical vegetation that fringed the protected shores and retreating to deeper waters when attacked by the fierce carnivorous dinosaurs of the land. After death the carcass would usually be more or less dismembered and pulled apart by fishes or aquatic carnivora before it drifted into a quiet spot and was buried in the slowly accumulating mud.

The subsequent geologic ages, which piled successive deposits of sand and clay above him and finally brought his remains again to the surface after millions of years of burial and slow petrifaction, have witnessed vast changes in the world of life. The various dinosaurs, terrestrial and aquatic, which were his contemporaries, and the great variety of land and water life of his time became extinct, only to be succeeded by another long period of evolution of new kinds of dinosaurs of even more extraordinary types, although none attained the gigantic size of the Sauropoda. Then these in turn disappeared, and the way was left clear for the evolution of the mammals or higher vertebrates into the various types of living quadrupeds, and toward the end of this long period, in some region yet unexplored, the progenitors of man evolved from the monkey ancestry into the culminating type of evolution.

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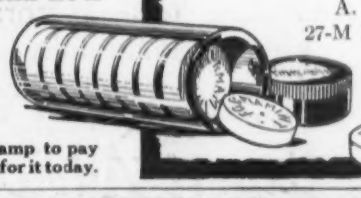

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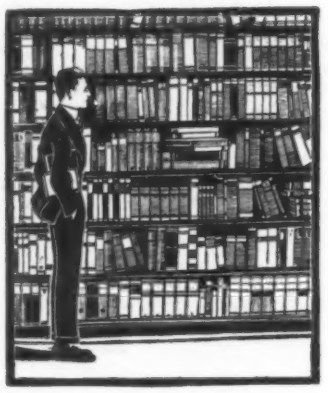

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